A CLINICAL STUDY OF THE EFFECT OF DIFFERENT ENDOTRACHEAL TUBES ON THE INCIDENCE OF POST-OPERATIVE LARYNGO-TRACHEITIS

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C E R T I F I C A T E

This is to certify that the work of Dr. Pradeep Kumar Khattri on "A CLINICAL STUDY OF THE EFFECT OF DIFFERENT ENDOTRACHEAL TUBES ON THE INCIDENCE OF POSTOPERATIVE LARYNGOTRACHEITIS" which is being presented by him for M.D.(Anaesthesiology) examination, 1986, has been carried out in the department of Anaesthesiology.

He has put in the necessary stay in the department as per university regulations.

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C E R T I F I C A T E

This is to certify that the work entitled "A CLINICAL STUDY OF THE EFFECT OF DIFFERENT ENDOTRACHEAL TUBES ON THE INCIDENCE OF POST-OPERATIVE LARYNGOTRACHEITIS" which is being presented by Dr. Pradeep Kumar Khattri for M.D. (Anaesthesiology) examination 1986, has been undertaken by him under my direct supervision and guidances. His observation and results have been checked and verified by me from time to time.

He has put in the necessary stay in the department according to the university regulations.

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(PRADEEP KUMAR KHATTRI)

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INTRODUCTION

INTRODUCTION

Endotracheal intubation, although known as early as seventeenth century, is no doubt a boon to the present day anaesthesiologists. No matter whether used for administration of anaesthesia or as a life saving procedure, in intensive therapy unit, this technique ensures a flawless respiration which is the chief concern of anaesthetist during anaesthesia and intensive therapy.

Apart from so many glittering advantages, that it provides, endotracheal intubation is also not unassociated with several major and minor complications and side effects. These side effects have been reported almost about a century after the introduction of this technique in clinical practice.

The so called postoperative "sorethroat syndrome" is still the problem and so many modifications in endotracheal tube design have been made by various workers now and then, without encouraging results. This syndrome, seen in the postoperative period is characterised by sorethroat, hoarseness of voice and difficulty in swallowing. True etiology to this problem has so far been eluding the anaesthetist, although several factors have been blamed as possible culprits. These factors which include infection, reaction to the material of tube, dry gases, local

anaesthetics, pressure of tubal cuff on tracheal wall, effect of humidification on inspired gases, effect of lubrication etc., have all been studied by various workers showing conflicting results. Even after so many improvement in endotracheal intubation technique and various modification in endotracheal tube design, the prevention of this problem has yet not been derived at conclusively.

Various workers have also studied the effect of nitrous-oxide diffusion into endotracheal tube cuff and found over-expansion of cuff due to diffusion of nitrous-oxide into cuff leading to increase cuff tracheal contact area, causing enhanced incidence of postoperative sorethroat. Several workers have given different methods to eliminate this problem of nitrous oxide diffusion into cuff.

Effect of lubrication of endotracheal tubes on the incidence of postoperative sorethroat is also contraversial. Different workers have given different views about the effect of lubrication on the incidence of postoperative sorethroat. It is only a mechanical advantage that lubrication provides, while others says about the effect of local anaesthetic that the lubricants contain in it. So varying are the results about the effect of lubrication on the incidence of postoperative sore-throat, that it becomes genuine to study the effect of the same.

Minimum study is carried out about the effect of tube on the incidence of postoperative sorethroat. Various workers have given conflicting results about the effect of

material of tube on the incidence of postoperative sorethroat, so it is also included in the present study.

Same is the situation about the effect of type of cuff on the incidence of postoperative sorethroat. Various workers have given different views about type of cuff to be used to minimise the incidence of postoperative sorethroat. Whether cuffed tube increases or decreases the incidence of postoperative sorethroat, is also contraversial. So effect of cuff on the incidence of postoperative sorethroat is included in the present study.

There is also not so extensive study of type of inhalational agents used during anaeathesia, on the incidence of postoperative sore throat. But Ether is taken as agent used in the present study to eliminate the variable of type of inhalational agents used. Some workers have studied and given results that incidence of postoperative sorethroat is maximum when ether is used as sole inhalational agents.

To summarise, the basic aim of the present study is to look into the following factors, as to how they affects the incidence of postoperative sorethroat -

1. Endotracheal tubes made up of different material.
2. Lubrication.
3. Cuffed tubes & plain tubes.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Endotracheal intubation has firmly established its place in modern anaesthetic practice and also in resuscitation. Time and again various workers have reported changes in larynx and trachea, both micro and macro-scopic after a long intubation period.

Laryngeal complications of endotracheal anaesthesia are divided into major and minor groups by Wolfson (1958) who presents a complete review of the literature on both major and minor sequelae.

Briefly major sequelae include granuloma formation, contact ulcer, subglottic membrane, subglottic oedema, tracheitis, haemorrhage of vocalcord, oedema of cord, larynx or trachea, Paralysis of vocal cords and perforation of trachea or oesophagus. Case reports of granuloma formation and contact ulcer appear most frequently in the literature, whereas the other complications are bizzare and unusual.

Minor complications of endotracheal anaesthesia are, on the other hand of common place occurrence. Minor sequelae reported in several series include mild and severe sorethroats, hoarseness, pain and difficulty in swallowing, pharyngeal ulceration and aphonia.

HISTORY

C. Kite of Gravesend described oral and nasal intutbation for resuscitation of the apparently drowned in 1788, Intubation from the neck, through a tracheostomy wound, was performed in 1858 by John Snow in anaesthetizing animals. Trendelenberg (1844-1924) used the mehtod in man in 1871, occluding the trachea by an inflatable cuff.

Wm. Mac Ewen of Glasgow in 1878 passed a tube from the mouth into the trachea, using his fingers as a guide in the conscious patients. Karl Maydl of Prague employed the tube of Joseph P o'Dwyer of cleneland, designed for the treatment of laryngeal diptheria in anaesthesia (1893).

In 1907 Bathelemy and Dufour of Nancy, France used insufflation endotracheal technique in men using chloroform. Elslerg & others in 1909 applied. in-sufflation endotracheal anaesthesia by tube in man.

Alfred Kirstein of Berlin and Gustav Killian of Freiberg - The original bronchoscopist-Pioneered direct laryngoscopy in 1895 and 1912 respectively and chevalier Jackson of Philadelphia published a book on the subject in 1907. This popularized direct larangoscopy. First blind nasal intubation was performed by Stanley Rowbotham of London (1920).

Inflatable cuffs have been used for many years, but were reintroduced by waters and guedel in 1928.

A pilot balloon was described in 1893 by Eisenmenger and was reintroduced by Langton Hewer in 1939.

Before the days of muscle relaxants, blind nasal intubation was very popular as it was usually quicker than direct vision oral intubation when intubation agents were all that were available. Indirect laryngoscopy with a laryngeal mirror was pioneered by Manuel Garcia, a teacher of singing in London in 1855.

In recent years the attitude to intubation has altered radically because the use of muscle relaxants and especially the use of suxamethonium has made intubation relatively easy, quick and atraumatic.

The use of muscle relaxants has greatly increased the need for intermittent positive pressure ventilation and this is more satisfactorily carried out if the patient is first intubated.

ENDOTRACHEAL TUBES - The traditional tubes are the wide bore Magill tubes of mineralized rubber. They can be used for either nasal or oral intubation, the latter having thicker walls. The number of tube corresponds to the internal diameter ~~of~~ in millimeteres. Other tubes are made of semirigid material. The portex plastic tube (Polyvinyl chloride) being useful (Eustac B.R. et al 1969).

Another type of tube is made of a spiral coil of nylon embedded in latex to prevent kinking (Hollinger T.H. et al 1944). The oxford or inverted L-Shaped tube (Allop A.F. 1955), has two limbs which are shaped to the passage from the mouth to the trachea and so can not Kink, even when the head is fully flexed. Its internal diameter is the same throughout but the thickness of that part which lies in the mouth and pharynx is twice that of distal part. The tube can be passed between the cords as it is or else on a curved stylet or a long gum elastic introducer. Inflatable cuffs can be incorporated with the tubes.

Tubes should be cleaned with soapy water outside and inside with test-tube brush. Heating to 75°C for 10 min. (Pasteurization) will Kill vegetative organisms which are potentially harmful, although relatively harmless spores will not be Killed. Rubber tubes can be autoclaved upto six times without much deterioration. Disposable tubes are very costly for use. Tubes may be supplied already sterilized by gamma ray . Tubes can be dipped in Glutaraldehyde (Cidex 2%) for 30 min., for sterilization after cleaning.

INFLATAFLE CUFF - Tubes, with internal diameters in the larger sizes can be supplied with inflatable cuffs.

Cuffs are used to ensure air tight tracheal anaesthesia instead of pharyngeol gauze packing. The Hewer pilot balloon shows the state of the cuff. When it is hidden in the trachea. There is the danger, when using the cuff, of causing sloughing of tracheal mucosa. The pressure in the cuff when comfortably inflated may be 120-180 mm of Hg but this does not correspnd to the pressure applied to tracheal mucosa.

Cuffs should not be inflated to a pressure greater than that needed to prevent audibie leakage of gas when the reservoir bag is compressed.

Various cuffs exert different pressures (Mackenzie C.F. et al 1976). The integrity of inflatable cuffs must always be tested before use. Separation of cuffs at their margin has been reported, leading to leaks. Nitrous Oxide has the ability of diffusing into air inflated latex cuffs and may thus cause over.expansion and trauma to mucosa (Stanley T.H. et al 1974).

As cuffs prevent leakage between the wall of the trachea and outer wall of the tube, they are useful in intermittent positive pressure ventilation. They also prevent gastric contents, blood, mucus and vomitus from entering the lungs and so are essential in intestinal obstruction with regurgitant vomiting and in operation

on the upper air passage.

LUBRICANTS - To intubate atraumatically, the tube and laryngoscope should be smeared with either a greasy or water soluble lubricant. A local analgesic can be incorporated such as lignocaine 2-4% while soft yellow paraffin is the better lubricant for blind nasal intubation, its water soluble substitutes will not cause Pneumonitis, if they reach the lungs. An analgesic - containing lubricant will increase tube tolerance and reduce the incidence of extubation spasm after short operations. Solutions and viscous are better than jelly.

HISTORY OF POSTOPERATIVE SORETHROAT

In 1950 Wylie found in a series of 100 patients that 70 patients complained of sorethroat upon direct questioning. In 1951 Baron and Kohlmoos two Otolaryngologists reported that everyone in a series of 80 patients complained of a mild sorethroat lasting at least 24 hours following endotracheal intubation. In 1958 Wolfson, in a review of 521 patients, found that 18.4 percent complained of sorethroat when questioned directly. In 1960 Conway and his groups found in 642 patients that incidence of sorethroat was 38.2 percent when the patients were questioned directly. Hortsell et al (1964), reported that postoperative sorethroat in 400 patients as 5.7 percent.

Loeser et al (1976). Loeser,Machih et al (1978a) reported sorethroat and hoarseness in 24-65 percents of patients intubated with cuffed tubes.

Various factors have been blamed for postoperative sorethroat.

POSTOPERATIVE SORETHROAT

DEFINITION AND CLINICAL FEATURES - A patient was considered to have a sorethroat if he complained of this either spontaneously or upon enquiry,postoperative sorethroat syndrome consists of scratchy feeling in throat, loss of voice, hoarseness and stridor. Sorethroat may be divided into mild or severe. A mild sorethroat was arbitrarily defined as one which lasted for one or two days only, unaccompanied by loss of voice or hoarseness or stridor. A severe sorethroat was defined as one which was accompanied by loss of voice or hoarseness or stridor or one which lasted for three days or more (Conway C.M. et al 1960).

FACTORS INFLUENCING INCIDENCE OF SORETHROAT - True etiology to this common problem has so far been eluding the anaesthetists, although several factors have been blamed as possible culprits. These factors include infections, reaction to the material of tube, dry gases, local

anaesthetists, lubrication, pressure of tubal cuff on tracheal wall etc. contributory factors which can lead to incidence of postoperative sorethroat syndrome include- unsterilized endotracheal tube, traumatic laryngoscopy, pharyngeal airway, Pharyngeal throat gauze packing, Ryle's tube, type of muscle retaxants used for intubation, skill of anaesthetist, difficult intubation, extent of movement of patient's head after in-tubation type of lubricant used on endotracheal tube, single or repeated application of lubricant, sex.

SEX - There is higher incidence of sorethroat in females (Wolfson 1958, Hortsell & Stephen 1964, Jensen et al 1982, Shah & Mapleson 1984), Gard & Cruickshank (1961), noted higher incidence in woman (56%) as compared with men (33%). Wolfson (1958), reported in 26.9% of females and 14.9% of males. Wolfson noted this due to higher incidence of contact ulcer and granuloma formation in the female. Jensen et al showed that women were more likely to develop sorethroat after intubation than men, a possible relationship between differences in cuff-trachea contact area is postulated.

Hortsell and Stephen (1964), noted complaint of sorethroat three time more frequently in females than in males. Conway et al (1960), found no difference

in male and female on incidence of sorethroat.

NASOGASTRIC TUBE - Conway et al (1960), found that sorethroat occurred twice as often in patients in whom a nasogastric tube was utilized. Gard and Cruickshank (1961), reported effect of Levin tubes on incidence of sorethroat, with Levin tubes 48% and 43% without Levin tubes had complaints, he further noted that trauma due to oesophogeal tubes does not become severe enough to cause symptoms until second or third day post-operative and becomes progressively worse after that time. Hortsell and stephen (1964), reported that incidence of sorethroat was doubled when nasogastric tube was employed.

However Hortsell and Stephen (1964), further noted in a small series of patients who were anaesthetized by mask only, with nasogastric tubes in place and found no complaints of sorethroat and he further noted effect of nasogastric tube on incidence of sorethroat, as etiological factor is not clear.

TRAUMA - Trauma at the time of intubation often is believed tobe related to development of sorethroat (Hortsell and Stephen 1964), Trauma may be produced by laryngoscope or by manipulation of endotracheal tube indifficult intubation. Hortsell and Stephen noted that traumatic intubation did not increase the incidence of sorethroat significantly.

COUGHING AND BUCKING - Sorethroat developed almost twice as frequently in patients who had bucking episodes with the endotracheal tube in place (Hortsell and Stephen 1964), same author further reported no cause and effect retationship in this respect.

TOPICAL ANALGESIA - Conway (1960), found no difference when a topical analgesic was applied. Gard and Cruickshank (1961), reported that a local spray to the larynx before intubation did not appear to alleviate sorethroat, but it did make far smoother anaesthesia, as it prevented bucking movements at the time of onset of the operation, before the lubrication had time to work. Hortsell and Stephen (1964), reported an increase in incidence of sorethroat among the group who received topical analgesia. They had given no explanation for the finding. They further noted that incidence of sorethroat was greater when the anaesthetic gas applied by transtracheal route than when it was instilled directly into the trachea in an atraumatic manner through the larynx.

PHARYNGEAL GAUZE PACKING - Conway et al (1960), noted that insetion of gauze pharyngeal pack moistened with water was associated with a high incidence of sorethroat.

MUSCLE RELAXANTS - Conway et al (1960), reported that there was not statistically significant difference between incidence of sorethroat after suxamethonium and that after gallamine tri-ethiodide and tubocurarine. They further reported a trend toward a greater frequency of sorethroat after suxamethonium and lesser frequency after gallamine. They have given possible explanation for this is that the relexation provided by gallamine unlike suxamethonium does not wear off rapidly and thus does not expose a lightly anaesthetized patient to the risk of bucking on at endotracheal tube. The increased incidence of sorethroat after suxamethonium may be a part of muscle pain syndrome (Conway et al 1960), Gallamine might be expected to provide slightly better intubating conditions than d-tubocurarine as its onset of action is more rapid.

Capan and Colleagues (1983), have shown a much higher incidence of sorethroat when suxamethonium was used than when it was not, in female patient who were not intubated and not paralysed with a non-depolarizing neuromuscular blocking drug.

But Shah and Mapleson (1984), showed no marked difference between suxame-thonium group of patient on

incidence of postoperative sorethroat and deduced that striking difference from the results of Capan and co-workers (1983), must be attributed to some difference in experimental or patient population-transatlantic differences in response to neuro-muscular blocking drugs (Katz et al 1969).

POSITION AND HEAD MOVEMENT - Gard and Criuckshank (1961) reported that of their patient, only 43% had sorethroats when there had been little or no head movement, whereas 58% compained when there had been frequent head movement and 53%, when the patient had been turned to prone position.

DIFFICULT INTUBATION - Among the commaner cause of difficulty of intubation case a bull neck, prominent incisor teeth, a stiff neck and laryngeal and masseter spasm. Conway et al (1960), found no increased incidence of sorethroat with these factors.

EFFECT OF LUBRICATION - Practical aspect of lubrication of endotracheal tube is important and it is studied by Gard and Cruickshank (1961), they have shown that creams are generally more desirable then jellies, because jellies tend to dry out quickly and become hard and sticky on the endotracheal tubes when applied any length

of time prior to operation. Cream persist roughly 30 to 50 minutes and jellies 15 minutes. Same authors have also studied about the influence of the various types of lubricants and their single or repeated application on incidence of sorethroats following intubation.

Gard and Cruickshank (1961) have shown that lowest incidence of complications occurred with one application of pramoxine cream that is 35% as opposed to 43% pramoxine jelly, 54% for K-Y jelly. The 38% incidence of complications with repeated use of K-Y jelly is probally not significant according to same authors because of the small number of cases involved. According to Gard and Cruickshank repeated lubrication to overcome the piston action of the endotraeheal tubes did not significantly lower the incidence of sorethroat except with K-Y jelly when the percentage dropped from 54% to 38% on repeated application.

Conway et al (1960) reported that use of local analgesic or other lubricants on the tube did not alter the incidence of sorethroat except in the case of Cinchocaine ointment which was associated with the high incidence of sorethroat. They further reported that this may be due partly to the greasy base of the preparation used, which

might dissolve some irritant substance ~~form~~ from the rubber of endotracheal tube.

But Winkel and Knudsen (1971) have shown that patients might benefit from lubrication of tracheal tubes with 1% Cinchocaine jelly.

According to Jensen et al (1982) Lubrication of traeheal tubes provides no advantage in terms of reducing sorethroat after operation.

Loeser, Stanley et al (1980) reported that lubrication with 4% lighocaine jelly containing polyethylene and propylene glycol was associated with increased complaints after operation.

Christine Stock and Downs (1980) studied effect of lubrication of endotracheal tubes with many lubricants which include-water soluble jelly, normal saline solution, lidocaine 2% jelly and lidocaine $1\frac{1}{2}$% ointment. They concluded that patients who received lubricated tubes complained of sorethroat and hoarseness to the same extent as those who received non-lubricated tubes. In addition the presence of lidocaine in the endotracheal tube did not alter the incidence or severity of sorethroat or hoarseness when compared with those who received tubes prpared with lubricants and which did not contain lidocaine.

Lund and Daos (1965), found the incidence of sorethroat significantly decreased with a viscous lidocaine ointment compared with less viscous lubricant with or without local anaesthetic agents added.

Therefore investigators who used reusable rubber latex or plastic tracheal tubes did not agree in their quest for a lubricant that would consistently decrease the occurrence of sorethroat.

Loeser and co-workers (1980), reported that compared with non-lubricated cuffed endotroeheal tubes uncuffed lubricated endopoefeal tracheal tubes provide no advantage in decrasing incidence of sorethroat. However these investigators did not examine the incidence of sorethroat complained when cuffed endotroeheal tubes were lubricated.

Christine and Stock (1980), found no significant difference in incidence or severity of sorethroat based on the type of lubricants used on tracheal tubes or based on the presence or absence of lidocaine in the lubricant. Infact they reported that there was no difference in the incidence or severity of sorethroat in patients who were intubated with dry tubes compared with those intubated with lubricated tubes.

Many investigators have reported that intubation was mechanically easier when some form of lubrication was applied to the tube.

DEFINITIONS - Cuffs mostly used in anaesthesiology are built-in the and slip-on cuffs.

RESIDUAL VOLUME - The amount of air which can be withdrawn from the cuff after it has been allowed to assume its normal shape in the natural intratracheal position with the inflation tube exposed to atmospheric pressure.

CUFF INFLATION VOLUME - The volume added to residual volume to abolish leak during IPPV.

INTRA CUFF PRESSURE - Pressure measured at the stated cuff inflation volume using Statham p-23-H Transducer (fluid filled) connected to the cuff inflation tube (air filled) via a three way stop cock.

TRACHEAL WALL PRESSURE - Pressure exerted laterally by the cuff on the head of an oil filled extension of Statham p-23-H pressure transducer which was implanted in the anterior tracheal wall.

SLOPE PRESSURE - The tracheal wall pressure produced in by inflating the cuff, 1ml beyond the no leak inflation volume.

EFFECT OF CUFF - Conway et al (1960), noted high incidence of sorethroat, when non-cuffed tubes were used. They have given a possible explanation for this is that the inflated cuff anchors the tube in the trachea, so that movement of

the tube relative to the trachea is unlikely to occur. Non-cuffed tubes may move freely in the trachea, larynx and Pharynx in response to movement of the patient's head or to respiratory movement.

According to Kamen and Wilkinson (1971) direct pressure from a distended balloon on the tracheal wall is the major etiologic factor in tracheal injury. The length of time, over which the pressure is maintained, contributes to the severity of injury. The safe pressure that the cuff may exert against the tracheal wall is a pressure that does not obliterate capillary blood flow that is less then 20mm of Hg. Tracheal cuffs in common use are not satisfactory for long-term application because of the excessively high pressure needed to produce an air tight seal.

Cooper et al (1969), showed that a standard cuffed endotracheal tube inflated to a point which prevented air leakage while a patient was ventilated at 20-25cm H_2O had intraluminal pressure of 180-250mm of Hg and c-t pressure of 200mm of Hg.

Foam filled cuff of Kamen and Wilkinson (1971), exert pressure against tracheal wall less than those necessary to produce tissue necrosis and it is atraumatic and can be used in full stomach because cuff is rapidly self-inflating when the negative pressure is released.

Stanley et al (1974), reported that Nitrous-Oxidehas the capacity to diffuse into the latex rubber endotracheal tube cuff in significant volumes and suggest that such diffusion may result in over-expansion of the cuffs and cause upper airway obstruction and trauma in intubated patients.

According to Tenney et al (1953), and Eger and Saidmen (1965), have shown that an enclosed gas filled space in the body will expand if it contains a gas (nitrogen) which is less soluble in blood than the gas respired (Nitrous-Oxide).

An air inflated endotracheal tube cuff with-in the trachea represents a gas filled pocket in the body.

Stanley et al (1974), reported that Nitrous-Oxide diffuses in to cuff of latex endotracheal tube, same author also have quantitated the cuff volume changes and rates at which they occur during exposure to various concentration of nitrous oxide.

Both Tenney et al (1953), and Eger and Saidman (1965), reported that two main factors govern the rate at which increase in volume take place in gas enclosed space in the body.

1. The rate increases when the blood flow to the space or the blood flow space volume ratio increases.

2. The rate increases as solubility of respired gas in the blood increases.

Other factors which influences rate of diffusion through a semipermeable membrane and might effect the rate at which nitrous-oxide or any other respired gas moves into an enclosed gas filled space include -

- Temperature
- Gram molecular weight of respired gas
- Its permeability through or solubility in the tissue making up the wall of the space.
- The pressure differential of the respired gas across this wall

Stanley et al (1974), reported that cuff wall thickness, partial pressure difference of nitrous-oxide and oxygen across the cuff wall and possibly the solubility of these gases and nitrogen in latex rubber are the most important determinant of rate of gaseous diffusion into and out of latex rubber air filled endotracheal tube cuff.

Stanley et al (1974), further reported that endotracheal cuff volume changes were directly releated to the partial pressure differences of nitrous-oxide across the wall of the cuff. They further noted that although less diffusible than nitrous-oxide, oxygen also contributed to

an increase in endotracheal tube cuff volume when its concentration gradient across the cuff wall was high (75% out side the cuff versus 20% inside). When lower concentration of oxygen were used that is 50% passage of oxygen into the cuff was negligible less than 1mm in 4 hours. Nitrogen diffusion was the least of these gases studied.

Stannett and Szware (1955), has shown that oxygen is 3-4 times more diffusible than nitrogen through most polymer membranes.

Barrer et al (1958), has shown that the process of permeation of gases through a plastic or rubber membranes occur as a sequence of three phenomana -

1. Absorption and solution of the gas into the membrane at the one surface.
2. Diffusion of gas through the body of the membrane.
3. Dissolution and freeing of the gas from the membrane at the other surface.

According to Stanley et al (1974), at least one of these phenomena is impaired in the diffusion of Nitrogen as compaired with Nitrous-oxide, through standared latex rubber endotracheal tube cuffs.

Stanley et al (1974), have shown that intra-cuff pressure below 100mm. Hg have not been shown to result in lateral tracheal wall pressure above normal systolic

arterial blood pressure and therefore probably do not cause enough tracheal wall compression to produce tissue ischaemia.

Stanley et al (1974), reported that nitrous-oxide would appear to be a better cuff inflating gas than air or if room air were used, it would be important to deflate cuffs periodically in order to avoid build-up of endotracheal tube cuff volume and pressure during nitrous-oxide anaesthesia.

Stanley (1975), further studied the diffusion of nitrous oxide into cuffs. He found that 76 to 88% of the measured cuff volume changes were the result of diffusion of nitrous-oxide into cuff, while 2 to 10% were due to difusion of oxygen. Such over-expansion of cuff may be an important cause of tracheal or laryngeal trauma and post-operative sore throat in patients whose trachea have been intubated. Nitrous-oxide diffuses less rapidly through latex rubber than through PVC. He further reported that both high pressure and low pressure air filled endotracheal tube cuff sustain significant increase in cuff volume and pressure after exposure to nitrous-oxide and oxygen. While low pressure cuffs have lower initial and final cuff pressures than high pressure cuffs, pressure and volume changes are similar with two

and primarily caused by diffusion of nitrous-oxide into the cuffs.

Stanley (1975), noted that cuff volume changes are less invivo than invitro. One reason for less diffusion of nitrous-oxide invivo is that less cuff surface area is available for diffusion. Only inferior portion of cuff, the portion not in contact with the tracheal wall is exposed in inspired gases in intubated patients. Other reason for less diffusion of nitrous-oxide into cuffs, invivo than invitro, are higher initial and subsequent cuff pressure in the invivo study, resulting from tracheal wall restriction of cuff expansion. Increased cuff pressure must result in proportional increase in the partial pressure of all gases within the cuff. This tend to decrease the pressure gradiant across the cuff wall for any nitrous-oxide in the cuff and increase it for nitrogen, both of which hinder cuff volume expansion.

EFFECT OF TEMPERATURE ON NITROUS-OXIDE DIFFUSION

Stanley (1975), studied this, using distensible cuffs in his study, it is reasonable to assume that at least small component of both pressure and volume changes observed from inflation to deflation reflected an increase of cuff gas temperature. If the temperature of the cuff gases

were 20°C at the inflation and 37°C after a few minutes within the fuff, according to Gaylussac's law the maximum increase in the cuff pressure due to temperature change would be 17/273 or approximatley 6% of the pressure at the initial inflation. But all cuffs studied (Stanley 1975), not possessed fixed volume as the above gas law require, the amount of increase of cuff pressure caused by temperature change must have been significantly less than 6% is in the same reasoning and Charles's law, volume changes resulting from increase in temperature of cuff gases after initial inflation must also be negligible.

Stanley et al (1978), studied various physical characteristics of cuffs on which diffusion of nitrous-oxide into cuffs depend. They noted that diffusion rate into most cuffs varied inversely with cuff thickness and directly with the partial pressure of the nitrous-oxide. They have noted that Kamen-Wilkinson silastic cuffs was more permeable to nitrous-oxide than PVC cuffs.

The inflatable cuff should provide both airway seal during positive pressure ventilation and protection from aspiration without causing significant trauma to trachea. A serious practical dilemma exists because lateral wall pressure adequate to maintain tracheal seal may decrease or eliminate capillary flow in the lamina propria and cuff

to trachea pressure that permits capillary flow, may also permit gas leak and/or aspiration.

Stanley et al (1978), reported in experimental study chamber that cuff volume increases after exposure to nitrous-oxide varied with exposure time, cuff thickness, nitrous-oxide tension and cuff composition.

They further reasoned (1978), that intra cuff volume and pressure changes after nitrous-oxide anaesthesia can be minimized by filling the cuff with inhaled anaesthetic gases or using a low cuff pressure regulating device.

Furthermore they recommend in 1978, the desireable cuff characteristics to be as follow :-

1. Tear resistance.
2. Thin wall
3. Larger diameter
4. Large enough residual volume to "buffer" positive intra traeheal pressure.

Intracuff pressure during extubation in large diameter air inflated cuffs be controlled at "safe" level using a pressure relgulating devices. Cuff pressure may also be manually adjusted to a "safe" level with a syringe and accurate manometer. Filling large diameter cuff with the anaesthetic mixture during nitrous-oxide anaesthesia is an alternate method to maintain the intra cuff pressure constant.

CUFF TRACHEA CONTACT AREA, HIGH VERSUS LOW VOLUME CUFFS

Stanley et al (1978), observed that high residual volume, high tracheal contact cuffs, caused markedly higher incidence and greater severity of post operative sorethroat than low residual volume, low tracheal contact cuffs. Kamen - Wilkinson tubes with high residual volume cuffs also increase the incidence of post operative sorethroat. Thus tubes with high residual volume provide no advantage for short, term tracheal intubation as required for most opertaitons.

Same author reported that cuff-tracheal contact area is an important factor in the development of post-operative sorethroat.

Loesar et al (1980), reported the same findings. They reported that incidence and severity of post-operative sorethroat is highly correlated with the length of cuffs used on endotracheal tubes but not with intubation time, age of patient, type of operation or intracuff pressure. They reported that while large volume, low pressure, endotracheal tubes cuffs produce less average depth of tracheal mucosal erosion after approximately 6 hours of endotracheal intubation than do low volume, high pressure cuffs, tracheal erosion produced by former is evidenced over a much larger area of tracheal mucosa than that of latter.

Further, Loeser et al (1980), found that many large volume low pressure cuffs correctly manufactured wrinkle inspite of proper inflation and wrinkles result in a deep mucosal grooves.

A minor role of cuff pressure per se, was further reported in a study confirming that the frequency of post-operative sorethroat after tracheal intubation with high residual volume low pressure cuff is independent of cuff filling with a sample of the inspired mixture of gases, room air or saline (Stanley and Loesar 1979). Although the minor role of pressure seem to be established, it is known that cuff inflation beyond the seal point significantly increases the measured intra cuff lateral wall pressure and therefore possibly the cuff tracheal contact area too (Wu et al 1973).

Erikensen, Jensen et al (1982) reported that a low volume high pressure cuff induced sorethroat to a lesser extent than did high volume low pressure cuffs, provided that intra cuff volume were maintained at the level of just "seal" throughout anaesthesia, when intra cuff pressure in low volume high pressure cuffed tube was high and allowed to increase, this advantage disappeared.

In the study of Loesar et al (1978), it was shown that small resting diameter, small residual volume, low

tracheal contact, high pressures cuffs caused sore throat less often than did large resting diameter, large volume cuffs.

Based on cuff tracheal contact area jensen and Erikensen (1982) showed that women were more likely to develop sorethroat after intubation than men because there is much cuff tracheal contact area in women than in men.

Shah and Mapleson (1984), have shown negligible effect of intermittent adjustment of cuff volume, they alongwith Jensen and Colleagues (1982), have shown 80 or more patients in each group with incidents of 44% with adjustement and 46% without, a difference of -2% with approximate confidence limits of this difference -17% and +13% (Glantz 1981).

As mentioned above several previous studies (Loeser et al 1976, 1978, 1980, Jensen et al 1982) have compared "standard" high pressure low volume cuffs such as those on red rubber tubes (intra cuff pressure 30 to 40 KPa) with "floppy" low pressure high volume cuff (intra cuff pressure 2 to 3 KPa). These studies have consistently found a higher incidence of sorethroat with low pressure cuffs. Pooling the results of all four studies (Shah and Mapleson 1984) gives over 300 patients in each group with incidence of 56% and 29% a difference of 27% with approximate 95%

confidence limits of 20% and 35%.

MATERIAL OF TUBE - Shah and Mapelson (1984), have shown that the PVC (portex blue line) tube has an intermediate intracuff pressure of above 7 to 9 KPa and might therefore be expected to give intermediate results. However data of Shah and Mapleson (1984) shown a non-significant lower incidence with PVC tube than with red rubbers tubes. Whereas Jensen and colleagues (1982), found nonsignificant higher incidence. Combining the compressed "direct" scores of Shah and Mapleson (1984) with result of Jensen and colleagues, Shah and Mapleson (1984), have shown that it gives a total of 80 or more patients in each group with incidence of 45% red rubber, and 49% with PVC. This is a 4% greater incidence with the PVC tubes but with approximate confidence limits of 12% lesser to 19% greater.

EFFECT OF HUMIDIFICATION - Shah and Mapleson (1984), have shown the effect of humidification of inspired gases on incidence of postoperative sorethroat. They have shown incidence of 40% with humidification and 42% without with "direct scores", a difference of -2% with approximate confidence limits of -24% to +19%.

ANAESTHESIA ON MASK - Loeser et al (1976), have shown the fact that a mask technique is follwed by sorethroat is usually ascribed to the drying of mucous membrane after ventilation with dry gases and to the use of anrtisialogogues.

INFECTION - Infection in the postoperative period remains a formidable problem. The altered respiratory defence mechanism and impaired mucociliary clearance, is reported to be the cause of frequent respiratory tract infection after general and topical anaesthesia (Corsen 1973). Salivary and other upper respiratory tract secretions contain vast number of commercial bacteria, some of these are potential pathogens (Cruickshank R. 1968). Transmission of infection through anaesthetic equipment remains a distinict possibility (Joseph 1952, Kunds et al 1962, Jain et al 1980). As such respiratory infection in the postoperative period, is probably caused by commericial bacterial flora acting as pathogens due to changes in the local defence mechanism produced by anaesthetic agents used.

HISTOPATHOLOGICAL CHANGE IN LARYNX AND TRACHEA AFTER ENDOTRACHEAL INTUBATION

Histopathological changes in larynx and trachea after endotracheal intubation were noted. Endotracheal intubation with cuff tube cause histopathological changes in trachea and larynx more early than plain tubes (Kriplani T.C., B.P. Singh Chansoriya, I.J.A.). Same author noted on experimental animals that changes are more severe under ether anaesthesia and least with trichroro-ethylene, with halothane, gas+oxygen and

methoxy-flurane in between.

Chansoriya et al (I.J.A.) noted that in ether group the most striking difference has been increased degree of cellular oedema, besides this the trachea as a whole was soft in all three dogs, have studied. They postulated that if the same type of softening and oedema can be postulated in smaller bronchioles, it can initiates patchy atelectasis.

It has been suggested that all changes observed by author are transient and complete recovery occurs as a rule. The process of recovery starts soon after extubation and is complete within a week (Hilding and Hilding 1962). But alongwith other incriminating factors like hypoxya, hypercarbia, shock, infection, prolonged duration, lack of humidification etc., these changes may not heal properly and lead to other severe sequelae.

Changes under ether were maximum and possibility of further sequelae and pulmonary atelectasis have been envisaged. (Chansoriya et al I.J.A.) changes seen under ether doubt its use as sole anaesthetic agent for longer duration.

Lindhotni (1969) noted that if assisted respiration is done, this causes movement of tube along the longitudinal axis resulting in more rubbing of the tube against the epithelium.

Intrusion of oversize tube is known to cause ulceration and severe damage of trachea within an hour (Way and Sooy 1965).

Chansoriya et al (I.J.A.) noted on experimental animals, mild ischaemia at cuff site is due to pressure exerted by inflated cuff, congestion observed above and below the cuff has been attributed to impedance of venous drainage of the area due to increased pressure in the cuff as compared to the mean venous capillary pressure (Smith Knowson and Bassett 1974).

MATERIAL AND METHODS

MATERIAL AND METHOD

The present study was carried out on 160 patients of either sex of A.S.A. Grade I and II at M.L.B. Medical College Hospital, Jhansi coming in for various routine surgeries.

SELECTION OF THE PATIENTS -

CRITERIA - The patients selected were those exhibiting the following criteria -

1. Patients exhibiting upper respiratory tract infection and other respiratory problems, were excluded from the study.
2. They should not have had a nagogastric tube passed within one week preceding operation.
3. The selected cases must require oral intubation only.
4. Patients must have a free and unobstructed airway so as to facilitate easy and smooth intubation.
5. Patients coming in for any oro-/naso-pharyngeal procedure were not included in the study.
6. Any type of pharyngeal instrumentation other than laryngoscope and tracheal tube was a discredit to the selection for study.
7. Patients taking drugs which can alter the incidence of sorethroat, were also excluded from the study.

GROUPING - After selection, the patients were divided into following groups -

A- CONTROL CASES - Where anaestheaia was administered by mask only.

B- The patients in this group were intubated by a cuffed or plain oro-tracheal tube. It was further subdivided into 4 groups as follows-

I) Plain tube	)	
	)	Unlubricated
II) Cuffed tube	)	
III) Plain tube	)	
	)	Lubricated by 0.9% sterile
IV) Cuffed tube	)	normal salime.

Cuff used is high volume, low pressure type.

MATERIAL

1. Endotracheal tubes

Red rubber	)
White rubber	) both cuffed and uncuffed
P.V.C.	)

2. Laryngoscope (Macintosch)

3. Boyle's 'F' anaesthesia machine

4. Laryngeal mirror, for indirect laryngoscope postoperatively.

5. Drugs-Atropine, Thiopentone Sodium, Suxamethonium Ether 0.9% normal saline, glutaraldehyde (cidex) solution 2%, 0.1% chlorhexidine in 70% alcohol.

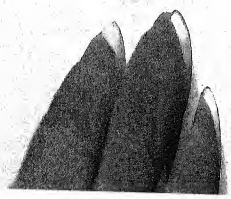
STERILIZATION - Endotracheal tubes and Magill's attachment of the boyle's machine were first cleaned with soap and water using brush and then immersing the same in cidex solution 2% for 30 minutes. Endotracheal tubes were used after washing thoroughly with water again.

Laryngoscope blade and endotracheal connections were sterilized by chemical sterilization using 0.1% chlorhexidine in 70 percent alcohal for 20 minutes.

PREPARATION OF THE PATIENT - Every selected patient was thoroughly examined both physically and systematically, giving special attention to upper and lower respiratory infection and any respiratory problem.

PREMEDICATION - 0.01-0.02mg/kg body weight injection atropine 1/M 45 minutes before operation.

ANAESTHESIA - Selected patients were given general anaeathesia by inducing with injection Thiopentone Sodium 3-4mg/kg and succinylcholine 1-1.5mg/kg then 100% oxygenation was given by mask and patient were intubated atraumatically with wide bore, Magill's selected Endotracheal tube, during direct laryngoscopy the larynx and oral cavity were again viewed for any inflammation and redness or congestion. No oropharyngeal air way was used.



Patients were maintained on oxygen, nitrous-oxide & ether, duration of intubation was minimum of 60 minutes. During extubation larynx and oral cavity was again viewed by direct laryngoscopy.

Control cases were administered anaesthesia by mask using oxygen, nitrous-oxide and ether.

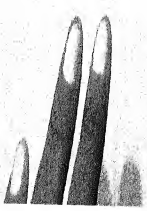
POSTOPERATIVE FOLLOWUP - Patients were followed up post-operatively upto one week. During followup patients were interrogated about symptoms of sorethroat viz. soreness, scratchy feeling in throat and/or hoarseness. Patient's oral cavity and larynx were viewed by laryngeal mirror after 24 hour of operation, on 3rd day and 7th day and any redness, congestion, oedema and ulceration were noted. Both subjective and objective findings by laryngeal mirror were noted and accordingly graded from 0-3 depending upon the severity of the problem-

0- No sore or scratchy throat at any time since operation and no evidences of hoarseness at the time of interview.

1. Minimal sore or scratchy throat for the same period and no hoarseness at the time of interview.

2. Moderate sorethroat and/or some hoarseness.

3. Severe sorethroat for the same period and/or obvious hoarseness at the time of interview.



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OBSERVATION AND RESULTS

OBSERVATION AND RESULTS

T A B L E - 1

AGE/SEX DISTRIBUTION OF THE PATIENTS STUDIED

INCIDENCE OF SORETHROAT ACCORDING TO AGE AND SEX OF THE PATIENTS:-

Age Group (Years)	TOTAL CASES				SORETHROAT PRESENT			
	MALE		FEMALE		MALE		FEMALE	
	No.	%	No.	%	No.	%	No.	%
0-10	12	14.45	7	14.58	5	41.66	5	71.40
11-20	12	14.45	6	12.50	5	41.66	4	66.67
21-30	12	14.45	7	14.58	5	41.66	4	66.67
31-40	12	14.45	7	14.58	5	41.66	5	71.40
41-50	12	14.45	7	14.58	4	33.34	4	66.67
51-60	11	13.25	7	14.58	4	33.34	4	66.67
61-70	12	14.45	7	14.58	5	41.66	4	66.67
	83	63.35	48	36.65	33	39	30	61

Above table shows that 33 out of 83 male patients exhibited sorethroat as against of 30 of 48 female patients, showing a higher incidence of sorethroat in female patients (61%) as compared to male patients (39%).

TABLE - 2

INCIDENCE OF SORETHROAT AMONG MASK AND INTUBATED GROUP

GROUP	TOTAL NUMBER STUDIED	SORETHROAT PRESENT		SORETHROAT ABSENT	
		No.	%	No.	%
1. MASK GROUP	29	10	34.5	19	65.5
2. INTUBATED GROUP	131	63	48	68	52

1. Above table throws light on incidence of sorethroat in control group. Out of 29 patients in mask group 10 patients complained of sorethroat giving an incidence of 34.5%.

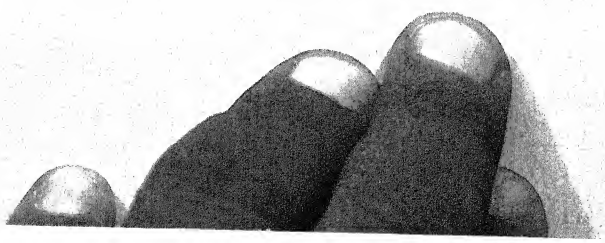
2. Out of total cases of 160 patients. 131 patients were in intubated group and in it, 63 patients exhibited sorethroat postoperatively giving an incidence of sorethroat 48%.

TABLE - 3

DISTRIBUTION OF PATIENTS ACCORDING TO THE GRADE OF SORETHROAT AMONGST INTUBATED PATIENT

GRADE	NUMBER	PERCENTAGE
0	68	52
I	22	16.8
II	23	17.5
III	18	13.7

Above mentioned table showed that sorethroat in intubated group is present in 48%, out of which 17.5% of Grade II, 16.8% of Grade I and 13.7 of Grade III.



T A B L E - 4

COMPARISON OF INCIDENCE OF SORETHROAT WITH DIFFERENT GROUP OF TUBES

GROUP	SORETHROAT PRESENT		SORETHROAT ABSENT	
	No.	%	No.	%
I-PLAIN LUBRICATED	4	13.8	25	86.2
II-PLAIN UNLUBRICATED	24	72.72	09	27.27
III-CUFFED LUBRICATED	10	29.4	24	70.6
IV-CUFFED UNLUBRICATED	25	71.43	10	28.57

(1) This table indicates the highest incidence of sorethroat in plain unlubricated group that is 72.72% and lowest incidence in plain lubricated group that is 13.8%, showing the effect of lubrication.

(2) Incidence of sorethroat in cuffed unlubricated group is 71.43% as opposed to 29.4% in cuffed lubricated group, indicating again the effect of lubrication.

(3) Incidence of sorethroat in plain lubricated group is 13.8% while in cuffed lubricated group it is 29.4%, giving the effect of cuff on incidence of sorethroat.

T A B L E - 5

INCIDENCE OF SORETHROAT WITH DIFFERENT TYPES OF MATERIAL OF TUBE

MATERIAL OF TUBE	SORETHROAT PRESENT		SORETHROAT ABSENT	
	No.	%	No.	%
I-WHITE RUBBER (41)	17	41.4	24	58.6
II-RED RUBBER (56)	26	46.4	30	53.6
III-P.V.C. (34)	20	58.7	14	41.3

Above table shows the highest incidence of sorethroat in the P.V.C. group that is 58.7%.

Incidence of sorethroat in red rubber group is greater than white rubber group, 46.4% in red rubber group as against 41.4% in white rubber group.

TABLE - 6

INCIDENCE OF SORETHROAT WITH DIFFERENT TYPE OF NONLUBRICATED PLAIN TUBES

INTUBATED GROUP	TOTAL :	GRADE OF SORETHROAT							
		0		I		II		III	
		No.	%	No.	%	No.	%	No.	%
I-WHITE RUBBER	05	2	40	1	20	1	20	1	20
II-RED RUBBER	20	5	25	3	15	8	40	4	20
III-P.V.C.	08	2	25	1	12.5	2	25	3	37.5
TOTAL	33	9		5		11		8	

(1) Above table shows that out of 5 patients in white rubber plain unlubricated group, 3 patients exhibited sorethroat, on each of Grade I, II and III giving an incidence of sorethroat in 60%.

(2) The 15 patients showed sorethroat of varying Grade out of 20 patients studied in red rubber plain unlubricated group giving an incidence of 75%.

(3) The 6 patients complained of sorethroat post-operatively, in 8 patients studied in P.V.C. plain unlubricated group giving 75% incidence of sorethroat.

T A B L E - 7

INCIDENCE OF SORETHROAT WITH DIFFERENT TYPES OF LUBRICATED PLAIN TUBES

INTUBATED GROUP	TOTAL	GRADE OF SORETHROAT							
		0		I		II		III	
		No.	%	No.	%	No.	%	No.	%
I-WHITE RUBBER	08	7	87.5	0	0	1	12.5	0	0
II-RED RUBBER	15	13	86.67	1	6.67	0	0	1	6.66
III-P.V.C.	06	05	83.33	0	0	0	0	1	16.67
TOTAL	29	25		1		1		2	

(1) Out of 8 patients studied in white rubber plain lubricated group, only one patient complained of moderate degree giving an incidence of 12.5%.

(2) The 15 patients studied in red rubber plain lubricated group, 2 patients exhibited sorethroat, one of mild and other of severe grade, giving an incidence of 13.33%.

(3) Only one patient exhibited sorethroat of severe degree, out of 6 patients studied in P.V.C. plain lubricated group giving an incidence of 16.67%.

T A B L E - 8

INCIDENCE OF SORETHROAT WITH DIFFERENT TYPES OF LUBRICATED CUFFED TUBE

INTUBATED GROUP	TOTAL	GRADE OF SORETHROAT							
		0		I		II		III	
		No.	%	No.	%	No.	%	No.	%
I-WHITE RUBBER	12	9	75.0	1	8.3	1	8.3	1	8.3
II-RED RUBBER	11	8	72.7	1	9.2	2	18.1	0	0
III-P.V.C.	11	7	63.6	0	0	2	18.18	2	18.18
TOTAL	34	24		2		5		3	

(1) Out of 12 patients in white rubber cuffed lubricated group 3 patients complained of sorethroat one each of grade I, II and III, giving 24.9% incidence of sorethroat.

(2) The 3 patients exhibited sorethroat in red rubber cuffed lubricated group out of 11 patients studied giving an incidence of sorethroat in 27.3%.

(3) The 11 patients studied in P.V.C. suffed lubricated group 4 patients exhibited sorethroat giving an incidence of sorethroat of 36.36%.

TABLE - 9

INCIDENCE OF SORETHROAT WITH DIFFERENT TYPE OF NONLUBRICATED CUFFED TUBE

INTUBATED GROUP	TOTAL	GRADE FO SORETHROAT							
		0		I		II		III	
		No.	%	No.	%	No.	%	No.	%
I-WHITE RUBBER	16	6	37.5	2	12.5	4	25.0	4	25
II-RED RUBBER	10	4	40	2	20	2	20.0	2	20
III-P.V.C.	09	0	0	2	22.22	2	22.23	5	55.55
TOTAL	35	10		6		8		11	

(1) The 10 patients exhibited sorethroat out of 16 patients studied in white rubber cuffed unlubricated group giving an incidence of 62.5%.

(2) Out of 10 patients in red rubber cuffed unlubricated group 6 patients exhibited sorethroat of varying grade with incidence of sorethroat of 60%.

(3) Out of 9 patients studied in P.V.C. cuffed unlubricated group, all patients exhibited sorethroat giving an incidence of sorethroat of 100%.

T A B L E - 10

TABLE SHOWING POSTOPERATIVE FINDING ON INDIRECT LARYNGOSCOPY

I/L FINDING	No.	%
REDNESS	24	18.30
CONGESTION	21	16.00
OEDEMA	18	13.70
ULCERATION	0	0

Above table given an idea about the finding of indirect laryngoscope postoperatively. Ulceration was not found in any case, while Redness, Congestion and Oedema were observed in 18.30%, 16.00 and 13.70 respectively.

DISCUSSION

DISCUSSION

Endotracheal intubation has been known for long time and has firmly established its place in modern anaesthetic practice and also in resuscitation. Apart from so many glittering gains, that it provides, endotracheal intubation is also associated with several major and minor complications and side effects.

Minor sequelae of endotracheal intubation include postoperative sorethroat, is still the problem. True etiology to this common problem has so far been eluding the present anaesthetist although several factors have been blamed as possible culprits.

Etiology of postoperative sorethroat is still not clear but numerous factors have been known responsible like infection, reaction to the material of tube, dry gases, local anaesthetics, lubricants, pressure of tubal cuff etc. Contributory factors blamed are unsterilized endotracheal tube, trauma by laryngoscope, pharyngeal airway, pharyngeal throat gauze packing, ryle's tube, type of muscle relaxant used for intubation, skill of anaesthetics, difficult intubation, extent of movement of patient's head after intubation etc.

So the present study is carried out to know the effect of various types of endotracheal tubes, effect of lubrication (normal saline 0.9%) and effect of cuff

(high volume low pressure) on incidence of postoperative sorethroat. The 160 in-patients were studied of either sex and of each group ranging from 5-70 years coming for various routine surgeries of A.S.A. Grade I & II only.

Patients were divided into two groups as mentioned earlier and minimum duration of anaesthesia was 60 minutes. Inhalational agent used in each patient was ether. Each selected patient was interrogated postoperatively about sorethroat and examined by laryngeal mirror upto one week for any evidence of laryngotracheitis and graded according to severity of sorethroat.

AGE/SEX DISTRIBUTION

Higher incidence of postoperative sorethroat has been reported in females (Wolfson 1958, Hortsell & Stephen 1964, Jensen et al 1982, Shah & Mapleson 1984, Gard and Cruick-shank 1961). Table no. 1 indicates higher incidence of sorethroat in females (61%) as compared to males (39%). There is no difference in age on incidence of postoperative sorethroat. Possible explanation for higher incidence in females is high cuff tracheal contact area and more tendency of contact ulcer and granuloma formation due to difference in anatomical conformity of trachea in females.

GROUP A (MASK GROUP) -

Loeser et al (1976) have shown the fact that Mask technique is followed by sorethroat is usually due to the drying of mucous membrane after ventilation with dry gases, to the irritant property of inhalational agent and to the use of antisialogogues.

Table 2 indicates that out of 160 patients studied, 29 patients were given anaesthesia by mask, out of which 10 patients developed sorethroat giving an incidence of sorethroat 34.5%. This is taken as control cases. The fact that mask technique is followed by sorethroat is ascribed to the drying of mucous membrane of larynx and trachea and irritant property of ether.

GROUP B (INTUBATED GROUP) -

Infection in the postoperative period remains a formidable problem. The altered defence mechanism and impaired mucociliary clearance is reported to be the cause of frequent respiratory tract infection after general and topical anaesthesia (Corsen 1973). Salivary and other respiratory tract secretions contain vast numbers of commercial bacteria, some of these are potential pathogens (Cruickshank, R. 1968) transmission of infection through anaesthetic equipment remains a distinct possibility (Joseph 1952, Kund et al 1962, Jain 1980). As such

respiratory infection in the postoperative period is probably caused by commercial bacterial flora acting as pathogens due to changes in the local defence mechanism produced by anaesthetic agents used.

Histopathological changes in trachea and larynx were reported more early with cuffed tube than with plain tubes (Kriplani T. C., B.P. Singh, Chansoriya I.J.A). same authors noted on experimental animals that changes are more severe under ether anaesthesia and least with trichloroethylene, with halothane, gas+oxygen and methoxy flurance in between.

Table 2 shows that 131 patients were given anaesthesia through endotracheal tubes, out of which 63 patients developed sorethroat of varying severity giving an incidence of 48%. Possible explanations for development of sorethroat, are altered defence mechanism of upper and lower respiratory tract following anaesthesia and ciliostasis, mucociliary impedance leading to more chances of infection due to both endogenous (normal bacterial flora) and exogenous (transmitted via anaesthetic machine) and also due to mucosal erosion caused by ischaemia and pressure necrosis of tracheal mucosa caused by orotracheal tube and its cuff leading to development of postoperative laryngotracheitis. Ether as irritant to tracheal mucosa and effect of antisialogogues (Atropine) used may be contributory factor in increasing postoperative sorethroat in intubated group.

MATERIAL OF TUBE -

The effect of the material of the tube on postoperative sorethroat, is controversial. Shah and Mapleson (1984) reported higher incidence of sorethroat with red rubber tubes than with P.V.C. tubes whereas Jensen and Colleagues (1982) have shown higher incidence with P.V.C. tubes.

Table nos. 0-05, (6-9) indicates higher incidence of sorethroat in P.V.C. tubes followed by red rubber and white rubber in that decreasing order. In white rubber tubes incidence is 41.4%, in red rubber tubes it is 46.4% and in P.V.C. tubes 48.7%, cause of this difference is not clear, probably it may be due to difference in composition of material of tubes leading to difference in reaction with tracheal mucosa and/or inhalational agent (ether) used.

EFFECT OF LUBRICATION -

Various workers have studied effects of lubricants using normal saline, lidocaine viscous, jelly, cream, ointment and suggested different views regarding their use. Creams are generally more desirable than jellies, because jellies tend to dry out quickly and become hard and sticky on the endotracheal tubes when applied any length of time prior to operation (Gard & Cruickshank 1961).

Conway et al (1960) reported that cinchocaine 1% ointment was associated with high incidences of sorethroat but Winkel and Knudsen (1971) have shown that patient might benefit from lubrication of tracheal tubes with 1% cinchocaine jelly. Conway et al (1960) have given possible explanation that greasy base of the preparation might dissolve some irritant substance from the rubber of endotracheal tube.

So varying are the results of lubrication that Jensen et al (1982) suggested lubrication of tracheal tubes provide no advantage in terms of reducing sorethroat after operation.

On the other hand Loeser, Stanley et al (1980) reported that lubrication with 4% lignocaine jelly containing polyethylene and propylene glycol was associated with increased complaints after operation.

Christine Stock and Downs (1980) studied the effect of lubrication of endotracheal tubes with many lubricants which include water soluble jelly, normal saline solution, lidocaine 2% jelly and lidocaine 2½% ointment. They concluded that sorethroat and hoarseness occurred to the same extent as those who received non-lubricated tubes. Lidocaine present in lubricants do not appear to decrease incidence of sorethroat.

So controversial is the effect of lubrication that many investigators have reported that intubation was mechanically easier when some form of lubrication was applied to the tube.

Method of lubrication used in the present study is sterile normal saline 0.9%. Incidence of sorethroat with lubricated group, both with plain and cuffed tubes was lower than unlubricated group (Table no. 4 (6-9)). In plain lubricated group incidence of sorethroat is 17.8% as compared to plain unlubricated tube in which an incidene as high as 72.7% was achieved. Likewise the incidence of sorethroat in cuffed lubricated group is 29.4% as compared to cuffed unlubricated group where it is 71.43% (Table no. 4 (6-9)).

In this study normal saline 0.9%, as lubricant appear to be the agent which has decreased the incidence of sorethroat. The reason for this may be isotonicity of normal saline making homeostasis constant and no reaction with the material of tube and mechanical advantage of lubrication with normal saline.

EFFECT OF CUFF -

Effect of endotracheal cuff on incidence of postoperative sorethroat has been studied by several workers from time to time and they have given controversial result

regarding its effect. Although cuff anchors the tubes and thereby decreases movement of tube with-in trachea but cuff can cause mucosal erorion of trachea leading to post-operative sorethroat. More so, when cuff is inflated to beyond the just seal point it causes pressure necrosis leading to postoperative sorethroat. Nitrous-oxide has the ability to diffuse into cuff and so causing the over-expansion of cuff leading to increased pressure necrosis of tracheal mucosa (Stanley et al 1974,1975 & 1978).

Cuff tracheal contact area is, an important factor in the development of postoperative sorethroat. Many authors have studied this fact. High volume low pressure cuff caused higher incidence of postoperative sorethroat than high pressure low volume cuff (Stanley et al 1978, Loeser et al 1980, Erikenson, Jensen et al 1982, Shah and Mapleson 1984). Possible explanation given are (1) That many large volume cuff wrinkles inspite of proper inflation and wrinkles result in a deep mucosal grooves. (2) Tracheal mucosal membrane or ciliary damage in direct relation to the cuff tracheal wall contactarea. (3) Bulkier and larger low pressure tubes produces more damage to upper airway structures on intubation or extubation (Loeser, Modges et al 1978, Jensen et al 1982).

But when intra-cuff pressure in low volume high pressure cuff tube was high and allowed to increase, the advantage of low cuff tracheal contact area disappeared (Erikensen, Jensen et al 1982).

Type of cuff used in the present study was high volume, low pressure and cuff is inflated to just seal point with room air.

In this work incidence of sorethroat in plain lubricated tube is 13.8% as compared to 29.4% in cuffed lubricated tube (Table no. 4) showing the effect of cuff on incidence of sorethroat.

Explanation for above result may be that tracheal cuff produce more damage to tracheal mucosa or ciliary activity in direct relation to the cuff tracheal wall contact area leading to ciliostasis, mucociliary impedance, stagnation of secretions, ischaemia and pressure necrosis of tracheal mucosa leading to altered defence mechanism of tracheal mucosa giving good ground for the development of infection, thereby causing laryngotrachcitis in postoperative period.

Hence in the end it can be concluded that the use of plain white rubber tube lubricated with 0.9% sterile normal saline would provide minimum incidence of postoperative sorethroat.

CONCLUSION

CONCLUSION

After the study on 160 patients and analysis of the data obtained, following conclusion was derived at :-

1. Incidence of postoperative sorethroat is higher in females than in males (61% in females, 39% in males).
2. In intubated group higher incidence of postoperative sorethroat is reported than in mask group (34.5% in mask group, 48% in intubated group).
3. Higher incidence is noted in P.V.C. group followed by red rubber and white rubber tubes in that order (48.7% in P.V.C. tubes, 46.4% in red rubber tubes, 41.4% in white rubber tubes).
4. In lubricated group, less patients exhibited postoperative sorethroat than in unlubricated group showing that 0.9% normal saline decreases the incidence of postoperative sorethroat (13.8% in plain lubricated group and 72.7% in plain unlubricated group, 29.4% in cuffed lubricated and 71.43% in cuffed unlubricated group).
5. High volume low pressure cuff used in the present study has increased the incidence of postoperative sorethroat (13.8% in plain lubricated tubes and 29.4% in cuffed lubricated tubes).
6. Incidence as well as severity of postoperative sorethroat is higher in P.V.C. group tubes.

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APPLICATION OF AMNIOTIC MEMBRANE AND FOETAL MEMBRANES (AMNION & CHORION) IN BURN : A COMPARATIVE STUDY

THESIS

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JHANSI

1984

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C E R T I F I C A T E

Certified that the work entitled " APPLICATION OF AMNIOTIC MEMBRANE AND FOETAL MEMBRANES (AMNION & CHORION) IN BURNS: A COMPARATIVE STUDY" has been carried out by Dr. Ajay Agarwal himself in this department.

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C E R T I F I C A T E

Certified that the work entitled " APPLICATION OF AMNIOTIC MEMBRANE AND FOETAL MEMBRANES (AMNION & CHORION) IN BURNS: A COMPARATIVE STUDY" has been carried out by Dr. Ajay Agarwal under my constant supervision and guidance. The results and observations were checked and verified by me from time to time.

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(AJAY AGARWAL)

CONTENTS

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INTRODUCTION

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INTRODUCTION

Thermal injury is a serious medical, social and economic problem. Almost every minute of the day, somewhere in the world atleast one human being becomes victim of burns. Burns and its sequelae are often the cause of personal and family tragedies. The world wide development of mechanization and motorization, the growth of heavy industry and of the chemical industry and the wide use of electric energy and ionizing radiation in science and technology contribute to the frequency of burns.

The effect of burns is complex, its treatment expensive, requiring great collective team effort. Many months of hospital treatment are frequently necessary to remove the immediate threat to the patient's life. Reconstructive procedures and therapeutic, vocational and social rehabilitation may last for many years before the patient is able to return to active life.

Burns produce wide raw areas. Coverage of these areas still remains inseparable part of treatment. Since early 19th century idea of autogenous skin grafting to cover the raw area came into existence and is being used. But it has got some limitations (i) if burn area is large, required amount of autogenous donor area is not available (ii) patients are already in shock and not fit for surgery. (iii) it itself produces raw area. Therefore various materials have been suggested by various workers, at different times, either biological or synthetic. Different

biological coverings are homograft skin, heterograft skin, collogen sheets, foetal membranes. Synthetic materials include various films, foams, fabrics, sprays, gels and laminates. One finds it very difficult to chose from such a wide range. An ideal material should have the following properties viz- adherence, water Vapour transport, elasticity, durability, intact bacterial barrier, non antigenic and non toxic, easy to apply and remove and inexpensive or cheap.

Escalating prices of drugs and other materials and phenomenal increase in cost of health care has made it difficult for the commoner to bear the expenses incurred during treatment of burns. As such it would not be inappropriate to develop a suitable efficient and relatively in-expensive treatment for burns that could benefit the poor section of our society. Keeping this in mind, the present study is conducted to evaluate the effect of amniotic and full thickness membranes(amnion & chorion) in burns, and to compare their results.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Ever since man first learnt to make fire, while on the one hand it has served the humanity tremendously, it is considered man's worst enemy for causing burns. The difficulties in the treatment of burns have been lamented by all writers for centuries. The information regarding burns is found in different literature.

Papyrus (1500 BC) had been using boiled cow dung topically. Indian literature shows that Sushutra used mixure of butter with red ochre or the bark of a fig tree. He also recommended debridement of severe burns with loose skin and flesh.

Adams(1939) reports that Hippocrates applied warm mixture over the burn and avoided separation by simple cleanliness. Paulus aeginata (AD 625-690) recommended application of moderate detergent materials which were not definitely heating or cooling.

Rhazes (AD 880-923) had been using white ointment composed of white lead oil of roses and wax. Apart from excision of contracted scars described by Celsus, surgery had no place in the treatment of burns with Greek and Romans. Volesco de Tarenta of Montpellier(1490) described method to avoid syndactyly in the burnt hands.

William Clowes(1544-1604) stands out in history as the first surgeon since the middle ages to use the physical signs of burns 'where the skin was burnt off, and the parts were made raw and painful' to indicate his local treatment.

Hildanus in his book Decombustionibus(1607) insisted that the classification of burns should be a guide for

treatment,classifying burns into three degree by external appearance; redness and blistering; withering and skin without charring; and eschar formation and charring. He warned against cooling burnt skin which would harden the tissues. In very deep burns, he made incisions to let the moisture escape, as otherwise gangrene and infection would supervene. So he was also the first to perform 'escharotomy'.

Wiseman (1676) observed that an organ which is burnt superficially is far more painful than the deep. He too classified burns into three degrees. Heister (1743) suggested a new classification into four degrees, including a time factor as a further diagnostic aid.

Sir James Earle (1799) described several cases of burns which he had treated with ice as an antidote. He suggested that application of cold to a burnt limb alleys pain, and if immediately applied, prevents the formation of blisters and limits the change to an area of erythema. Dzondi(1816) was the first person to carry out controlled experiments on dogs,which were scaled and treated with cold water.

Kentish(1797) justified his mode of treatment with oil of terpentine, which aims to 'diminish the increased action of system'. He had classified burns into two categories.

The Baltimore Medical and philosophical lyceum(1811) described carded cotton dressings, indicating the important principle of dressings a burn 'to give the most perfect protection and comfort'.

Boyer(1814) classified burns into three degrees : Erythema:Blistering leading to superficial ulcers ; and eschar. Dupuytren devided burns into six degrees : First erythema or superficial phlogosis which blanches on pressure. Second cutaneous inflammation , with the loss of

epidermis and the development of vesicles filled with serum. Third the destruction of a portion of the papillary body. Fourth the disorganization of the whole dermis to a subcutaneous cellular tissues. Fifth the formation of eschars of all the carbonization of the whole thickness of the burnt part.

Hebra (1861) treated burn patients in warm water baths. Believing that Dupuytrens last degrees of burns were of academic interest only, he returned to three degree classification (Hebree 1866) Erythema with swelling and pain; blistering with petichial hoemorrhage; eschar and devoid of sensations.

The 19th century presented two basic important principles for the local treatment of burns-skin grafting(Pollock 1871) and open treatment (Copeland Alabama 1887 , Stocker 1894 and Reid 1898). However Bouisson had used open treatment about 400 years back. Lusgarten (1871) suggested and Wilms (1901) carried out excision of burnt tissue for the first time but he never grafted the excised area. Jauschovic (1968) revived the idea of excision of burnt tissue and immediate skin grafting thus making a footnote to the contemporary principle of early tangantial excision and early grafting.

At the termination of 19th century, the combat was to avoid infection and within the 20th century pathophysiology elucidated causes and indicated methods of systemic treatment of burns, counteracting shock. Reiss (1890) and Tommasoli(1897) introduced the systemic treatment of shock by intravenous saline infusions in severely burnt patients. Brown(1896) and Sneve(1905) followed the same suit. But this treatment

became in fourth decade of this century, a routine pratice after the remarkable work of Davidson(1926), Underhill(1930) and Blalock(1931). Previously people had been using alcohalic drinks and opium for correcting shock in these patients.

This was the turning point, and since the mid 20th century, an increased understanding of the metabolic, nutritional, immunological and wound healing process have been recognised improving treatment and comfert of burn patients.

Oppenheimer(1906) advocated the use of picric acid therapy and Davidson (1925) Tannic acid in treatment of Burns. As a consequence, the popularity of the 'exposure' method rapidly declined and only in 1949 was this treatment revived by wallace.

Little pregress had been made from the ancient time in the local treatment of Burns. Man's main concern had been to reduce pain. To achieve this various medicaments from pigeon dung (Aegineta 1535) to enzymatic sloughing agents and antibacterial agents have been used.

Work of Leidbug, Reiss and Artz (1953)indicated septicaemia as primary cause of death in burns and staphylococci as the main organism. With the availability of antibacterial agents against gram positive organism, Pseudomonos emerged as the major organism responsible for sepsis and death. This led other workers to find out antibacterial agents that would penitrate scar. 5% Ag Noz (Moyor), Mefenide (Moncrief), Silver sulphadiazine (Foxe Jr & others), cerium nitrate (Williams W, Monofo, Soun N, Tandan) are the topical agents which minimize bacterial counts over the wound.

Burn Wound Coverings

Thermal injury results in striking anatomic,metabolic and physiologic disturbances which projudice survival of burn

patients. In major degree of burns, the patient is exposed to death from shock or toxaemia due to absorption of poisons from the injured surface or from loss of skin covering or from exhaustion due to the long continued fight for recovery or due to their combined effects.

Autogenous skin grafting is the best covering material, but it has its own limitation in terms of limited supply, unfitness of the already shocked patient for skin grafting. To overcome this problem, various biological and synthetic covering materials, either for short period till the healing of the wound or permanent in place of lost skin, have been suggested by different workers.

Biological Dressings :

Homografts

Pollock(1871), Girdner (1881) and Shede(1881) were the pa pioneers in this field. Ivanova (1890) suggested the advantageous use of foetal skin over the adult because the infantile tissue possessed more "energetic vitality" .

Dago(1952) introduced the use of Postmortem allografts as temporary biological dressings. The use of fresh Postmortem allografts have added measurably to the successful treatment of burns. As temporary biological coverings, they decrease fluid and protein loss,diminish infection and prepare granulating surface for the application of autogenous grafts.

Brown(1952) used allografts as emergency dressings for burn. He stated that the skin may be removed even days after death if the cadaver has been placed in cold storage.

Eade (1958) and Morries(1960) observed that the homografts have organizational and debride-mental effects on healing wound.

Healed epidermis shows alteration in the architecture and the dermis contains aedematous connective tissue in 2nd degree burns where homografts are not used. When the homografts are used, the healed epidermis shows normal architecture with recognizable basal layer and normal collagen bundles in the dermis (Miller 1967).

James O'Neill Jr(1967) used temporary homografts coverage over open wounds including 2nd and 3rd degree burns. Such coverage was of distinct benefit following eschar separation in burn injury. Sharma et al(1978) reported the same results.

Allografts skin, besides being satisfactory, biological dressings have their own limitations. Cadavers suitable for skin donations are limited in number. Bexter(1970) has estimated 6 physician hours and hospital cost of $225 per patient needed to use cadaver homografts.

Xenografts

The use of Heterologous tissue as a temporary dressings for full thickness skin defects was largely a result of the difficulty of obtaining adequate amount of homografts. Brown, Burleson and Lewis have shown that the adherence of allografts and xenografts is similar. Heterograft provides a readily available, easily stored and sterilized dressings in contrast to homografts. The only xenograft in common use is pig skin. Variable results have been reported with porcine xenograft coverage of donar sites and partial thickness burns ranging from early re-epithelization to conversion of full thickness skin loss. Salisbury(1973) has reported that incorporation of xenograft tissue on healing donar sites occurs in 35 percent of cases. There appears to be no significant difference in the effectiveness of fresh

compared with fresh frozen or frozen irradiated procine skin.

The most striking advantage with the procine xenograft is that of immediate and lasting pain relief. Xenograft has most of the properties of the ideal skin substitute. A viable xenograft is [illegible] antigenic but the dead is not. The major problem is the propensity to digestion by wound collagenase and subsequent infection.

Collagen Sheets

Collagen, fibrous protein is present in many animal tissue like skin, muscle and bone. Its structure and immunologic chemistry are well characterized and antigenicity can be altered. It also possesses a haemostatic effect; when implanted in pure from over a living animal tissue, no antigenic reaction is seen. Air borne infection is minimised and fluid loss is prevented. Thus it isideal raw material to be used in burns. It is derived from serous and sub serous layers of freshly slaughtered cattle intestine and are commercially available in 10 cm.X 15 cm size packed in cylindrical glass tubes containing ethylene oxide which acts as sterilizing agent.

Sinha (1972), Shankar (1975) and Gupta et al (1976) used collagen sheets as primary cover material in the managemnet of burns. Elhans et al (1978) used sheets as biological dressings in 22 patients and reported its role in prevention of infection and in increasing the rate of healing. Jain et al (1976) reported the similar findings.

Synthetic Materials

The problem associated with biological materials provided an impetus to search for synthetic material with ideal properties for a skin Prosthesis. Earlies research work was a sulfonamide film (Pickrell, 1942). Many of these materials

adhere by intrapment of coagulum in the interstices of the material. Silicon polymer membrane is the best material available because it is elastic, durable and the water vapour transfer characteristics can be controlled by varying the thickness. Kornberg et al (1972) have used thin silicon membrane bonded to cotton gauze for temporary skin substitution but it lacks elasticity and creats non uniform pattern of adherence. Other materials are modified polyvanyl chloride or similar plastics which provides more elasticity and water vapour transfer characteristics. (James et al, 1975, Lamkay et al, 1977, Towsend, 1977). The material is deep but the greatest disadvantage is lack of adherence to wound itself. These materials seem to have great promise as a temporary skin substitute for short time applications.

Amniotic Membrane

The quest for a cheap, painless and easily available biological dressing having most of the properties of the ideal skin substitute led people to use amniotic membrane.

Amniotic membrane is the inner of the two foetal membranes having two surface. Its outer surface is separated from the deciduous of the maternal uterus by chorion. The inner surface is in contact with the content of the amniotic sac i.e. the fluid and the foetal body.

A section of amnion under a light microscope shows 5 different layers :

1. Epithelium : This is a single layer of non ciliated cuboidal cells having a role in the exchange of fluids and electrolytes between amniotic sac and mother.
2. Basement membrane : This is a narrow band of reticular tissue at the base of epithelial layer adherent to it.

3. Compact layer : It is a dense acellular layer deep to basement membrane. It is firmly adherent to the basement membrane and cannot be separated from it normally.

4. Fibroblast layer : It is composed of fibroblast net work present in mesh of reticulum. Fibroblast and hofbour cells (Macrophages) are normally present in this layer. It forms a considerable part of the thickness of amnion.

5. Spongy layer : It is composed of extra embryonic coelomic reticulum. It is capable of great distension. It contains mucous in its structure which enables the layer to alter its shape.

The normal thickness of the membrane is 1/50 to 1/2 m.m. which may increase to as much as 2-5 cm. due to change in the amount of the mucin and fluid within the spongy layer and the capability of loose connective tissue to great variation.

The Chorion : The chorion consists of four layers, these are from within outwards:

1) Cellular layer : thin layer consisting of an interlacing fobroblast net work.

2) Reticular layer : It forms the majority of thickness of the fibrous chorion and consists of a relicular net work, the fibres of which tend to be parrallel. Nodes present on the fibres at those places where branching occurs.

3) Pseudo basement membrane : It is a layer of dense argyrophil connective tissue that is firmly adherent to the reticular layer above.

4) Trophoblast: It forms 2 to 10 layers of trophoblast cells in contact, on their deeper aspect, with material dicidua. This layer contains obliterated chorionic villi.

Blood Supply

Amnion does not have any blood supply at term as well as not at any stage of Pregnancy.

Nerve Supply: Nerve supply have not been described in the amnion but the findings have not been confirmed.

Lymphatic Vessels: Possibilities that amnion contains lymphatic vessels have been suggested by some workers.

Embryonic development :

In the human embryo, development of amnion begins during the transformation of morula to blastocyst stage at the time of implantation, about 7-8 days after fertilization. There is separation from inner all mass of the germ disc at the periphery of the ectodermal layer of polyhedral cells. " Amniogenic cells", to form a slitlike cavity, with appearance of primary extra embryonic mesoderm. The amniotic mesenchyme is derived epithelium becomes separated from the primitive trophoblast. Amniotic mesenchyme is derived from the primary extra embryonic mesoderm of the trophoblst.

Finally the foetal membrane consist of an inner amniotic membrane consisting of a single layer of ectodermally derived amnion cells. Collagen rich mesenchyme of 6-8 cells in the thickness. The chorion consisting of compressed trophoblastic tissue of the chorion leave and mesenchymal tissue.

Immunology

Various studies have been carried out to observe the facts concerning this important aspect of the subject.

Amnion when implanted to its own newborn infant"takes" as a permanent graft.Neovascularization has not been seen.Nourishment of the graft appears to be by simple diffusion.

When implanted sub cutaneously as allograft,results were similar to autograft for first 14-17 days. Later on these grafts were transformed into hylinised substances . Similar results

have been observed when amniotic membrane was used as biological dressing. When the mesenchymal surface was placed towards the host "superior take up" or "fixation" was seen, while on placing amnion towards host, little fixation was noticed at the end of 72 hours. No neovascularization was observed in any case.

The allograft amnion membrane appeared viable histologically after 21 days. When it was placed in pelvic cavity after pelvic exenteration, granulation tissue and fibroblast tissue activity was markedly inhibited as compared to control cases.

When allograft amnion was implanted intra peritoneally in the experimental animal in whom the caecum was damaged and contaminated, prevention of adhesions and gradual disintegration of membrane without any host response occured.

These experiments suggest that antigenicity of amnion is low and no voilent host reaction noted yet.

When the chorion was placed over host tissue as autograft and allograft neovascularization and migration of host cells was observed. It provokes strong cellular and less antibody response. The tissue had an accelerated rejection phenomenon in 72 hrs, being rejected by 11th day. This rejection phenomenon can be delayed by high doses of progesterone.

Clinical and experimental application

In 1910, Davis, a senior medical student reported attempts at grafting pieces of the lining of the amniotic sac onto granulating wounds.

Sabella(1912) for the first time treated a brunt patient, applying amniotic side of the membrane towards the wound because of its ectodemual origin and reported results as: Absence of infection, reduction in pain and rapid re epithelization. While Burger(1937) used Amnion in construction of vagina; De Roth(1940) reported its sucessful use in conjunctival repair.

Chao et al(1940) and Kohnstan (1941) suggested the use of "Amnio plastin", a preparation made by the immersion of amnion in alcohal for fixing, followed by drying in sheets and boiling in water for 20 minutes for sterilization. This was washed in normal saline before use. This fixed, dead amnion preparation was employed as a covering to prevent adhesions during operations on the brain. Later Pinkerton(1942) and others used it for mobilizing adherent tendon fixed by adhesions.

The credit for using living amnion as a homograft in burns goes to Kubani, a Hungarian. He also used sterile amnion to cover raw surface of the peritonium after separating adhesions. His contemporary, Henson(1950) used amniotic membrane in the management of chronic skin ulcerations with smooth side of amnion facing wound. He observed that granulation tissue never raised above margins which occured when plaster of paris was used to cover the wound.

Douglus(1952) used Heterografts(human skin to chorio-allentoic membrane of chick and human amnion to chick amnion) and reported successful results. He further applied heterografts in experimental dogs using amnion and chorion over the wounds. Healing was quick and infection was less and he noticed that dressings separated readily from the surface, grafted with amnion, leaving a shiny, dry and pinkish surface. The chorion grafts were more opaque and more salmon pink coloured.

Douglus(1951)also did the first successful homografting in an extensively burnt patient.

Douglus and other(1954) tranplanting homologous and heterologous chorionic membrane to the mouse concluded that homologous and heterologous grafts of foetal membrane are

tolerated as covering for open wounds as well as homologous grafts of skin and for two or three times the duration of the homografts of the skin. The transplants of foetal membrane served as viable transplants, capable of cellular division and epithelization. Their experiments indicated that chorionic grafts may be more useful as temporary coverage of wounds than are homoplastic skin grafts.

Jullian (1956) using the amnion membrane over old infected flame burns successfully, suggested the amniotic membrane as dressing material for emergency measurement of trauma.

Henson(1956) treated patients with intermittent claudication, grafting amniotic membrane and found favourable results. Similar results were reported by Rowling(1958) Unger-Hamiltan(1958) and Hansen(1960).

Pigeons(1960) contention in using amniotic membrane was that it is similar to skin as it arises from ectoderm of the foetus.

Massee et al (1962) reported favourable results with amniotic membrane grafts in experimental dogs where he carried out pelvic exenteration. They showed that there were few adhesions and dense scar formation.

Dino(1965) in his study using various layers of foetal membrane on burnt patient, observed that following application of membrane, there was immediate relief in pain. However, he did not report any allergic reaction, crust formation was there over grafted areas which remained dry and uninfected untill their pealing off(9th to 20th day) following grafting. He used amnion, amnion with chorion and chorion alone and did not find any difference after using these

layers.

Dino's next study(1966) was to find out the best preservative. He preserved the amniotic membrane in different sterile solutions at 4^{0}c Temp. viz.1 Normal saline 2.Benzal konium solution(1:1000 dilution) 3. sodium hypochloride (1:40 dilution) in normal saline solution 4. saline solution(500 cc) with 1 million units of crystalline penicillin and 1 gr. of streptomycin sulphate or Kanamycine. Amniotic membranes were preserved from fresh stage to one month and were used in treatment. Bacteriological examinations of membranes were done on 1st, 3rd, 7th and 30th day. He labelled solution of sodium hypochloride 2. Solution of crystalline penicillin with streptomycin sulphate or Kanamycin sulphate as best.

Galask et at(1970) observed the presence of several factors in the human amniotic membrane which are known to be antibactenal. They have clearly shown inhibition of number of bacterial genera by amniotic fluid, even by amniotic fluid supplemented by casein hydrolysate.

Trelford et al(1970) confirmed the observation of Douglus that the mesenchymal side towards the host provided more consistent 'take' while using amnion as auto and allografts in experimental sheep.

Robson et al(1973) studied the effect of human amniotic membranes on the bacterial population of infected rat burns. They concluded that compared to human skin, the amniotic membrane was more effective at decreasing the bacterial counts in the burn wounds. They sought specific antibacterial substance using invitro techniques with amniotic membrane homografts but no such substance was found, and proposed that the invitro antibacterial effect seen is due to achievement of a biologically closed wounds by the membrane, thus allowing

the host's own defence mechanism to deal with the bacterial population as did other biological dressings.

Robson et al (1973) treated 50 patients having open wounds with full thickness amniotic membrane. Over full thickness defects, the amniotic membranes were placed on the wound with the chorion against the granulating surface , changing them at every 48 hours. Before applying membrane and while changing the membrane, specimens were taken for bacterial analysis. In partial thickness wounds, membranes were applied with chorion facing the wound and in some, amnion facing the wound. They observed that amniotic membrane adhered to all wounds regardless of their depth. In all of the full thickness wound, the bacterial count decreased and the decrease was equal to allograft skin and superior to xenograft skin.

Colocho & others (1974) observed the effect of human amniotic membrane in clinical and experimental studies. Amniotic membranes were used to cover the split thickness donar sites and partial thickness burn wounds. In rats, open wounds were covered with amnion and in some, it was placed in sub-cutaneous pockets. None of the biopsy specimens showed vascularization of the amnion by the host. The membrane became dissicated forming a dry eschar over the surface of burn that gradually became detached as reepithelization proceeded beneath the membrane.

Bapat and Kothari(1974) successfully used living amniotic membrane grafts for the restoration of the floor of the mouth in the patients of advanced cancer of the tongue, following radical total glossectomy. They observed that the healing was rapid with induction of metaplasia in a

fore-night. Grafted area showed hardly any scarring. The floor remained flexible and pliable.

Trelford- Souder and other (1977) used the amniotic membrane to cover the raw area after pelvic exenteration and innumerated advantages as : Readily availability of low antigenic tissue, lack of intestinal complications, reduced fluid and protin loss, technically easy method, reduced hospitalization and reduced number of intro-abdominal adhesions.

Bose B(1979) used membrane as biological dressing's over burns, pointing out that amnion adheres more firmly than any other biological dressing. Agarwal V K (1982) reported similar results.

MATERIAL AND METHOD

MATERIAL AND METHOD

The present study has been conducted at M.L.B. Medical College Hospital, Jhansi from May 1982 to April 1983 to compare the effects of amniotic membrane and Full thickness foetal membrane (Amnion+Chorion) over thermal burns as bio-dressings.

Collection of membranes

The amniotic membrane and Foetal membranes were collected from the labour room and obstetric operation theatre of M.L.B. Medical College Hospital, Jhansi at the time of labour and caesarian section. The mothers having intact membranes and without any history suggestive of genital tract infection were selected. Parity and blood groups of mothers were not considered.

Separation of Membranes from placenta

The placenta with intact membrane was taken directly in a clean tray and was washed thoroughly in running tap water to remove blood and mucoid material then it was transferred to another clean tray filled with water. For full thickness membrane intact chorion and amnion was cut around placental margins and for amniotic membrane, it was separated from chorion starting from periphery upto the base of umbilical cord and was cut around . The separated membranes were spread over a flat surface in a sterile container filled with sterile normal saline and any remaining clots were removed gently from its surface with the help of sterile gauze pieces. These membranes

were again rinsed in sterile normal saline for four-five times.

Preservation of membranes

Membranes thus obtained were either applied immediately to burn area or kept separately in sterile normal saline treated with 10 lac units of Benzyl penicilline and 1 gm of Streptomycin sulphate and preserved at 4^{o}c till the time of application. The preserved membranes were continuously watched for bad odour or change in colour and texture. Membranes preserved for more than one month period were not used.

Selection of cases

All the cases having burn less than 50% of body surface, either deep or superficial, who came to emergency department or out patient department of this hospital within 72 hours of the thermal injury were included in this study, irrespective of their age, sex socio economic status, contamination of wound and mode of injury.

Method of Study

The selected cases were subjected to detailed history and physical examination which were recorded on following lines :-

(i) History

Introduction : Name, Age, Sex, Occupation, rural/urban, address, date of admission, date of discharge and time of healing .

- Date and time of burn (duration)
- Place of accident and nature of work at the time of accident.
- Cause of burn

- Prior treatment (if any)
- Symptoms

(ii) Physical examination

General Examination: The case was examined for general condition, pulse, blood pressure, temperature, respiration and hydration.

Local Examination :

(A) Percentage of Burn : It was calculated by "Wallace's rule of Nine" in the adult and by "Lund and Browder Chart" in children.

(B) Depth of Burn : Superficial/deep.

Estimation of depth of Burn:

The hypodermic needle was used to test the pain sensation. The area with increased sensibility was considered to be superficial or partial thickness burn. The area with markedly reduced or absent pain sensibility was considered to be deep or full thickness burn. This was also confirmed by pulling out a hair from burn surface. In the third degree or deep burn hair pulls out easily and without pain. This test is of value in borderline cases of second degree burn. In addition, help of the following criteria was also sought :

Classification of depth	Appearance of Burn area	Pain sensation
I degree	Erythematous	Painful and hyperaesthetic.
II degree		
(A)	Blisters with reddened base and moisture	Painful and hyperaesthetic
(B)	Blisters with Blanched base and moisture	Painful, hyperaesthetic or anaesthetic at places
III degree	Leathery pale or pearly white or charred dry.	Painful and anaesthetic

The I and II (A) were considered as superficial and II (B) and III were considered as deep burn.

(C) Contamination of wound

Apparently clean : No contamination of foreign body, clean intact blisters.

Mild contamination : Slight contamination, ruptured blisters, open wounds.

Gross contamination : Heavy contamination with dirty cloth, foreign body, dust and/or cowdung, mud etc.

(D) Area involved : Diagramatic representation of area involved was made.

Resuscitation and general treatment

Prior to application of membranes, patients were resuscitated and general treatment was given to every patient(i.e. $^{1}/_{v}$ infusians, blood and plasma infusian, analgesic, antibiotics and tetanus prophylaxis).

Local management of wound

Patients were devided into following groups :

Group 'A' : Amniotic membrane was applied over full burn area.

Group 'B' : Full thickness foetal membrane was applied over full burn area.

Group 'C' : Amniotic membrane was applied over one part (C_1) and full thickness membrane on ether part (C_2).

Procedure :

The burnt areas to be grafted were prepared by throughly debriding the dead skin and cleaning them with 5% savlon solution and sterile saline solution. Spirit was applied over adjacent normal skin. After this burnt areas were again assessed for degree and percentage of burn.

Fresh or preserved membrane (amniotic membrane or full thickness foetal membrane) was stretched out and was applied on the burnt surface. The application was done in such a way that the membrane extended beyond the borders of the burn, overlapping the normal skin. This was done to help keep the membranes in place since it adheres easily to dry skin. The amniotic membrane was applied with smooth surface facing the wound while full thickness membrane was applied with chorion facing the wound.

In movable areas like the exhimities and joints, the graft was held in place by covering it first with sterile gauze then bandaging with sterile rolled gauze. In relatively immovable parts like the chest and abdomen, the membrane was left alone as applied without any additional dressing.

No anaesthetics were used on the burn areas before membrane application.

Assessment of the case

The assessment of the results was done daily following the application of the membranes.

The patients were asked about :

1. Pain and discomfort prior and after application of membranes.
2. Fever
3. Any evidence of allergy as itching, rashes, nausea, vomiting.

Physical Examination

General Examination: Patients were examined for general condition, hydration, pulse, blood pressure and signs of toxaemia.

Local Examination : Observation for the following was done :

(1) Presence of discharge and /or soakage.

(2) Appearance of membranes as regard to surface, margin, thickness, lustuure, colour, dryness and adherence.

(3) Collection of Pus under dressing: if the Pus was localized in small area underneath membranes, a slit was given in it and pus was squeezed out. A Pus swab was taken for culture and sensitivity. If the pus was present underneath th the whole of the membrane then membrane was removed, Pus swab was taken for culture and sensitivity and wound throughly cleaned. The 2nd application of membrane was done after control of infection.

1) Result of healing

Investigations :

1. Routine - Complete blood haemogram
   - Urine- gross and microscopic examination.
2. Culture and sensitivity test for Pus if present.

Pus swab was taken for culture and sensitivity and antibiotics were given according to reports.

PROFORMA

Name

Age/Sex

Occupation

Rural/Urban

Address

Date and time of admission.

Date and time of discharge.

Group

Total time of healing

HISTORY

(i) Date and time of burn

(ii) Place of work and nature of work at the time of burn

(iii) Cause of burn

(iv) Prior treatment (if any)

SYMPTOMS

(i) Pain

(ii) Burning

(iii) Blisters

(iv) Fever

(v) Oliguria

(vi) Discharge from wound surface

(vii) Difficulty in swallowing or in inspiration

(viii) Any other

PHYSICAL EXAMINATION

(a) General examination at the time of admission

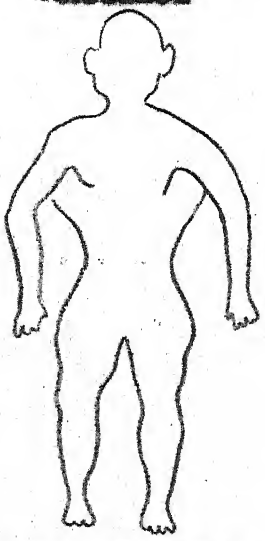
-G.C. -Pulse -B.P.

-Temperature - Hydration

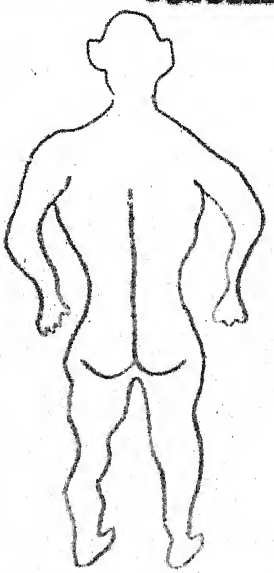
(b) Local examination

- Percentage of burn
- Depth of burn/Degree of burn
- Contamination
- Appearance of raw surface area
- Area involved (Diagramatic)

Anterior



Posterior



Lateral

Progressive report -

Days	1	2	3	4	5	7	9	12	14	18	21	25	30	35
G.C.														
Pulse														
B.P.														
Hydration														
Temperature														
Difference between input & output														
Albumin in Urine														

	Wound dressed with amniotic membrane													Wound dressed with full thickness membrane										
Days	1	2	3	4	5	7	9	12	15	18	22	25	30	1	2	3	4	5	7	9	12	15	18	22
Pain																								
Soakage																								
Mobility																								
Biodressing changes -																								
(a) Surface																								
(b) Margins																								
(c) Thickness																								
(d) Lusture																								
(e) Colour																								
(f) Dryness																								
(g) Adherence																								
Healed on																								
Time of healing																								

Investigations

Blood - TLC
DLC
Hb%
ESR

Urine - Albumin
Sugar
M/E

Pus - Culture & Sensitivity

Treatment

(i) I/V fluids
(ii) Blood
(iii) Sedative
(iv) Analgesics
(v) Systemic antibiotics
(vi) Local application

Photograph-1: Showing seperation of amnion with chorion from the placenta .

Photograph-2: Showing seperation of amnion from chorion.

Photograph-3: Showing seperation of amnion upto the base of umbilical cord.

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OBSERVATIONS

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OBSERVATIONS

The present study consists of 31 patients of Burn admitted in surgical and emergency wards and also as O.P.D. cases in surgery at M.L.B. Medical College, Jhansi from may 1982 to April 1983. These patients belonged to different social strata and were of either sex. These patients had age group ranging from 3 months to 50 years and had burns involving less than 50 per cent of total body surface area. only those cases were included who reached hospital within 72 hours of having sustained burn injuries.

Of the total 31 patients, 30 patients were below 30 years of age. 9 cases (2 males and 7 females) i.e. 29.032% were below 10 years of age, 10 cases (5 males and 5 females) i.e. 32.258% between 11-20 years of age and 11 cases (5 males and 6 females) i.e. 35.484% were between 21-30 years of age. The only patient above 30 years of age was a male of 50 years. Total male patients were 13(41.936%) and female patients 18 (58.064 %).

Table No. 1

Showing age incidence

S.N.	Age groups	Number of cases	% age
1.	0 - 10	9	29.032
2.	11 - 20	10	32.258
3.	21 - 30	11	35.484
4.	31 - 40	0	-
5.	41 - 50	1	3.226
	Total	31	100

Table No.2

Showing Sex incidence in difference age groups

S.N.	Age groups (Years)	Male		Female	
		Number	%age	Number	% age
1.	0 - 10	2	6.452	7	22.580
2.	11 - 20	5	16.129	5	16.129
3.	21 - 30	5	16.129	6	19.355
4.	31 - 40	-	-	-	-
5.	41 - 50	1	3.226	-	-
	Total	13	41.936	18	58.064

Maximum burn injuries 26 (10 male and 16 female) i.e. 83.871% occured at home when the patient was engaged in his daily home tasks. 5 patients (16.129%) sustained burns while working out door, of these 3 were male and 2 female.

Table No. 3

Showing location of Burn accident in different Sex

S.N.	location	Male		Female	
		Number	% age	Number	% age
1.	Indoor	10	32.258	16	51.613
2.	Outdoor	3	9.677	2	6.452
	Total	13	41.936	18	58.064

14 (45.161%) out of 31 patients hailed from rural area and 17(54.839%) from urban.

Table No. 4

Showing rural/urban incidence

S.N.	Rural/ Urban	Male	Female	Total	% age
1.	Rural	7	7	14	45.161
2.	Urban	6	11	17	54.839
	Total			31	100

It was observed that 21 patients (15 females and 6 males) i.e. 67.74% sustained burn injuries from fire while

cooking food. 3 patients i.e. 9.667%(2 male and 1 female)suffered burn injuries from fire. 5 patients i.e. 16.129% (3 male and 2 female) had burns due to scalding and one male patient suffered injuries while working on electric installation. 26 cases were superficial and 5 were deep burns.

Of the 31 patients, 7 were housewives, 3 farmers, 12 students, 1 electrician and 1 patient was doctor who suffered injuries from fire-crackers.

Table No.5

Showing cause of burn according to sex

S.N.	Cause of Burn	Male		Female		Total	
		Number	% age	Number	%age	Number	%age
1.	Fire during work or cooking	6		15		21	67.742
2.	Lamp	2		1		3	9.677
3.	Scalding	3		2		5	16.129
4.	Electric Current	1		-		1	3.226
5.	Miscellaneous	1		-		1	2.226
	Total	13		18		31	100

Table No.6

Showing different occupation among the burn patients

S.N.	Occupation	Number of cases	% age
1.	Housewives	7	22.581
2.	Farmer	3	9.677
3.	Labourer	1	3.226
4.	Student	12	38.710
5.	Electrician	1	3.226
6.	Professional	1	3.226
7.	Miscellaneous	6	19.355

16 patients i.e. 51.613 out of 31 reached hospital within 12 hours of injury. 8 patients (25.806%) reached within 13-24 hours. 6 patients (19.355%) attended hospital within 24-48

hours and one patient(3.226%)reached hospital after 70 hours of injury. Off all these cases,14(45.161%)were apparently clean wound, 13(41.935%)mild contaminated and 4(12.903%)were grossly contaminated wound.

Table No.7

Showing time interval between burn accident and hospital arrival

S.N.	Duration in hours	Number of cases	% age
1.	0 - 12	16	51.613
2.	13 - 24	8	25.806
3.	25 - 36	4	12.903
4.	37 - 48	2	6.452
5.	49 - 60	0	-
6.	61 - 72	1	3.226
	Total	31	100

Table No. 8

Showing the grade of contamination of wound at the time of admission

S.N.	Grade of contamination	No. of cases	% age
1.	Apparently clean	14	45.161
2.	Mild contamination	13	41.935
3.	Gross contamination	4	12.903

In 11 cases (35.494%) membranes were applied within 12 hours of injury, in 9 within 12-24 hours, and in another 9 between 24-48 hours. Only in one case membrane was applied within 49-60 hours and in one case after 70 hours of injury.

Table No.9

Showing time interval between burn accident and application of membrane

S.N.	Time interval in hours	No.of cases	% age
1.	0 - 12	11	35.484
2.	13 - 24	9	29.032
3.	25 - 36	6	19.355
4.	37 - 48	3	9.677
5.	49 - 60	1	3.226
6.	61 - 72	1	3.226
	Total	31	100

Out of 31 cases to whom membranes were applied, 15 cases (48.387) were having less than 10% burns, 8 cases 11-20 %, 3 cases 21-30% and 5 cases were having 31-40% of burns. These were devided into three groups. In 18 cases, only amniotic membrane was applied, in 8 cases, Amnion with chorion was applied and in 5 cases both membranes were applied to different wound areas.

Table No. 10

Showing Percentage of burn

S.N.	Percentage of burn	Number of cases	% age
1.	0 - 10	15	48.387
2.	11 - 20	8	25.806
3.	21 - 30	3	9.677
4.	31 - 40	5	16.129
5.	41 - 50	-	-
	Total	31	100

Table No. 11

Showing the number of cases in different group according to local management of wound

S.N.	Group	No. of cases	% age
1.	A	18	58.065
2.	B	8	25.806
3.	C(C_1+ C_2)	5	16.129
	Total	31	100

Thus total 31 cases with 36 wound areas were considered. In 23 wound surface, only amniotic membrane was applied and 13 wound surface, Amnion with chorion was applied.

Table No. 12

Showing the percentage of Burn surface over body treated by different group.

S. No.	Percentage of burn	Total Amniotic Membrane				Total full thickness membrane			
		Treated Wound		Total	%age	Treated Wound		Total	%age
		A	C_1			B	C_2		
1.	0 - 10	9	2	11	47.826	6	1	7	53.846
2.	11 - 20	6	2	8	34.783	1	4	5	38.462
3.	21 - 30	1	1	2	8.696	1	-	1	7.692
4.	31 - 40	2	-	2	8.696	-	-	-	-
5.	41 - 50	-	-	-	-	-	-	-	-
	Total			23	100			13	100

Total area 36

In the clinical observations, following main criteria were considered viz., relief of pain and discomfert, development of fever and allergic reaction, control of oozing and gross infection. The duration of healing and condition of wound after separation of membrane were also compared in two different types of membrane application.

Out of 23 amniotic membrane treated wounds, immediate relief of pain and discomfert was recorded in 22 cases(95.652%) and in only one case, analgesics and sedatives were required. Similarly of the 13 full thickness membrane treated wounds, only one patient(7.692%) required analgesics and sedative for persistent pain and discomfert. No allergic reaction was seen in any case. Fever was noticed in 7 cases, all development infection.

Table No.13

Showing the immediate effect of different dressings

Type of dressing	Group	Total wounds	Pain and discomfort						Allergic reaction
			Relieved			Persisted			
			No.	Total	% age	No.	Total	% age	
Amniotic Membrane	A	18	17	22	95.652	1	1	4.348	-
	C_1	5	5			0			-
Full thickness Membrane	B	8	8	12	92.307	0	1	7.692	-
	C_2	5	4			1			-

In 26 cases, oozing stopped within 24 hours of application of membrane. In one case, oozing stopped within 36 hours and in 4 cases, oozing stopped in 36-48 hours. All these cases were deep Burns.

It was observed that in all wounds treated by amniotic membrane, it became dry and adherent to wound surface within few hours of application (6 hours- 12 hours) whereas full thickness membrane took longer time (12-24 hours) to become dry and adherent to wound surface.

In about 24-48 hours, both types of membrane covering the adjacent normal healthy skin started curling up but remained adherent to wound surface. In about 2 days, amniotic membrane became opaque and as membrane dried, its colour changed from yellowish to light brown. Full thickness membrane was white opaque when applied and as it started drying, it became more transparent in 24-48 hours and then its colour changed dark yellowish brown.

23 of the membranes(17 Amnion and 6 Amnion with chorion) were used within 6 hours following procurement. 5 Amnion with chorion and 3 Amnion were used after being preserved for 1 day, one Amnion and 2 Amnion and chorion after 3 days, one Amnion

after 6 days and one Amnion after 15 days and no differences were noticed with regard to using the membranes in various duration of preservation.

7 wounds (6 to which amniotic membrane was applied and one to which full thickness membrane was applied) developed soakage. Culture showed that soakage was due to pus formation in these cases.

Table No.14

Showing the incidence of soakage and Pus formation after 2 different type of dressings.

Type of dressing	Total wound	Soakage		Pus formation	
		No.	% age	No.	% age
Amniotic Membrane treated wound	23	6	26.087	6	26.087
Full thickness membrane treated wound	13	1	7.692	1	7.692

Two amniotic membrane treated wounds developed staphylococcal infection, two developed pseudomonas infection, one wound developed staphylococcus and Klebsiella and one wound developed staphylococcus and E coli infection. One full thickness membrane treated wound developed Pseudomonas infection.

Table No. 15

Showing Bacteriology of wound surface treated by two different types of dressings.

Type of Bacteria	Amniotic membrane treated wound	Full thickness membrane treated wound
1. Staphulococcus	4	-
2. Pseudomonas	2	1
3. Klebsiella	1	-
4. E coli	1	-

Of the 23 wounds treated with amniotic membrane, 3 wounds (13.043%) which involved 0-10% of body surface area, healed in 6-10 days, 10 wounds (43.478%) healed within 11-15 days time of which 4 had 0-10% of Burns, 3 had 11-20% of burns, 2 had 21-30% of burns and 1 had 31-40% of burns. 4 wounds healed within 16-20 days time, 2 having 0-10% burns, 1 involving 11-20% burns and 1 involving 31-40% Burns. One case involving 18% of Burns in leg expired on 20th day due to septecaemia. 3 wounds (113.043%) healed in 21-25 days, 2 involving 0-10% Burns and 1 involving 11-20% Burns. 1 wound (4.348%) involving 11-20% Burn surface healed in 26-30 days and one wound(4.384%) involving 11-20% Burn surface healed in 36-40 days.

Of all 13 wounds treated with full thickness membrane, 7 wounds i.e. 53.846% (6 involving 0-10% of body surface and one wound involving 21-30% of body surface), healed in 6-10 days, one wound (7.692%) involving 11-20% of body surface in 11-15 days. Two wounds (15.385%) having 11-20% of Burns healed in 16-20 days. Two wounds (15.385%), one having 0-10% Burns and one having 11-20% Burns healed in 21-25 days time. One wound (7.692%) involving 11-20% of body surface took 36-40 days to heal.

Out of 36 wounds in total rejection of membrane occured in 5 Amniotic membrane treated wounds and 1 full thickness membrane treated wound. Pus collection underneath the membrane appeared to be the main cause of rejection. In these cases membrane were reapplied after control of infection. In 2 of 6 cases where membranes were reapplied, rejection again occured probably due to failure of control of infection. These cases were later treated by antibiotic gauze piece and

Showing the rate of healing in burns treated by the different types of dressings in different of % age of Burns.

Total days of healing	Amniotic membrane treated group (23)							Full thickness membrane treated group(13)						
	Percentage of Burn areas					Total		Percentage of Burn area						
	0-10	11-20	21-30	31-40	41-50	No.	%age	0-10	11-20	21-30	31-40	40-50	No.	%age
6-10	3	-	-	-	-	3	13.043	6	-	1	-	-	7	53.846
11-15	4	3	2	1	-	10	43.478	-	1	-	-	-	1	7.692
16-20	2	1	-	1	-	4	17.391	-	2	-	-	-	2	15.385
21-25	2	1	-	-	-	3	13.043	1	1	-	-	-	2	15.385
26-30	-	1	-	-	-	1	4.348	-	-	-	-	-	-	-
31-35	-	-	-	-	-	-	-	-	-	-	-	-	-	-
36-40	-	1	-	-	-	1	4.348	-	1	-	-	-	1	7.692
Total						23							13	

One patient with 11-20% of Burn expired on 20th day.

Table No.17

Showing the result after two different types of membrane application

Type of dressing	%age of Burns	Total wound surface	Rejection	Reapplication			Contracture	Keloid
				Accepted	Again rejected	Mortality		
Amniotic Membrane treated wounds	0-10	11	3	3	-	-	-	1
	11-20	8	1	-	1	1	1	-
	21-30	2	-	-	-	-	-	-
	31-40	2	1	-	1	-	1	-
	41-50	-	-	-	-	-	-	-
		23						
Full Thickness membrane treated wounds	0-10	7	-	-	-	-	-	1
	11-20	5	1	1	-	-	-	-
	21-30	1	-	-	-	-	-	-
	31-40	-	-	-	-	-	-	-
	41-50	-	-	-	-	-	-	-
		13						

systemic antibiotics according to culture and sensitivity of Pus. All these cases were either grossly or midly contaminated at the time of admission in the hospital.

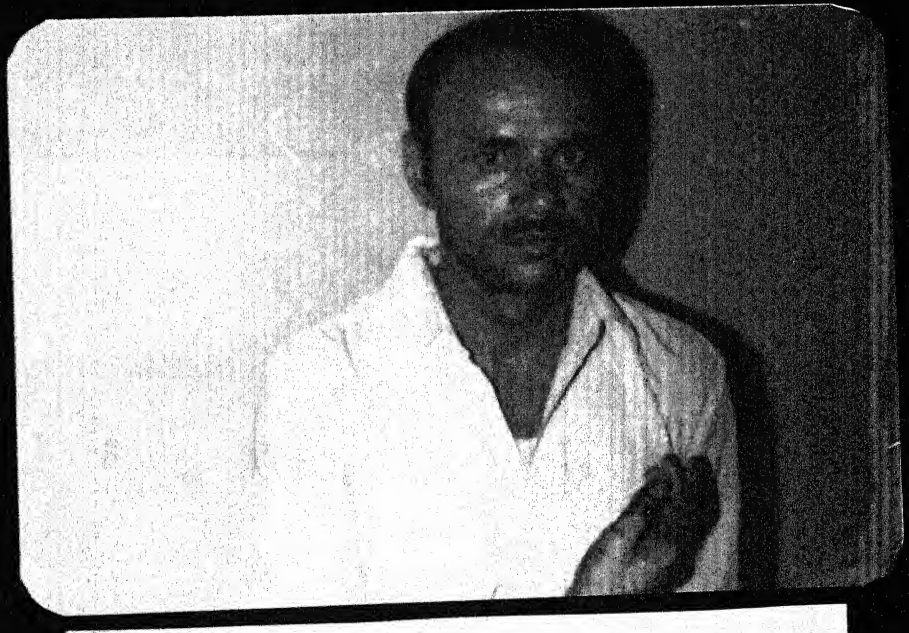
2 amniotic membrane treated cases developed contracture both involving the area of neck. One amniotic membrane treated wound and one full thickness membrane treated wound developed Keloid after complete healing.

29 Out of 36 wound surfaces were cured with good healing over the surface. Healed wound surface was pink, smooth and had flat margins. Four healed wounds had pink and raised surface with flat margins. One amniotic membrane treated wound and one full thickness treated wound had red, raised surface with flat margins. Both latter wounds developed Keloid later on.

Photograph-4: Burn wounds just before application of membrane.

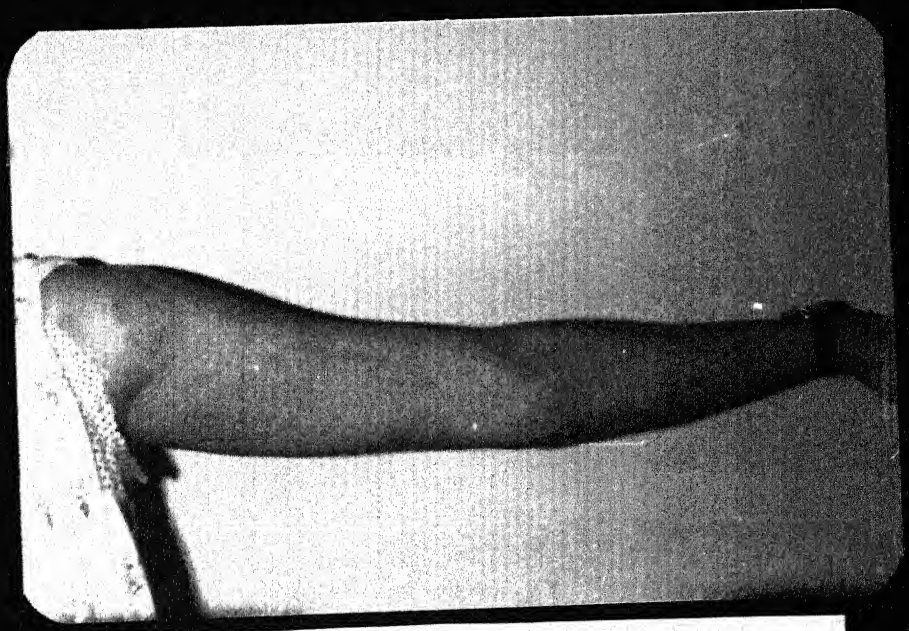
Photograph-5: Burn wounds just after application of full thickness membrane.

Photograph-6: Full thickness membrane after 36 hours of membrane application. Showing the appearance of dried membrane.



Photograph-7: Same patient as in photo-graph-4, showing complete healing of wound (10th day after application of membrane).

Photograph-8: Showing burn wounds after 24 hours of amnion application.

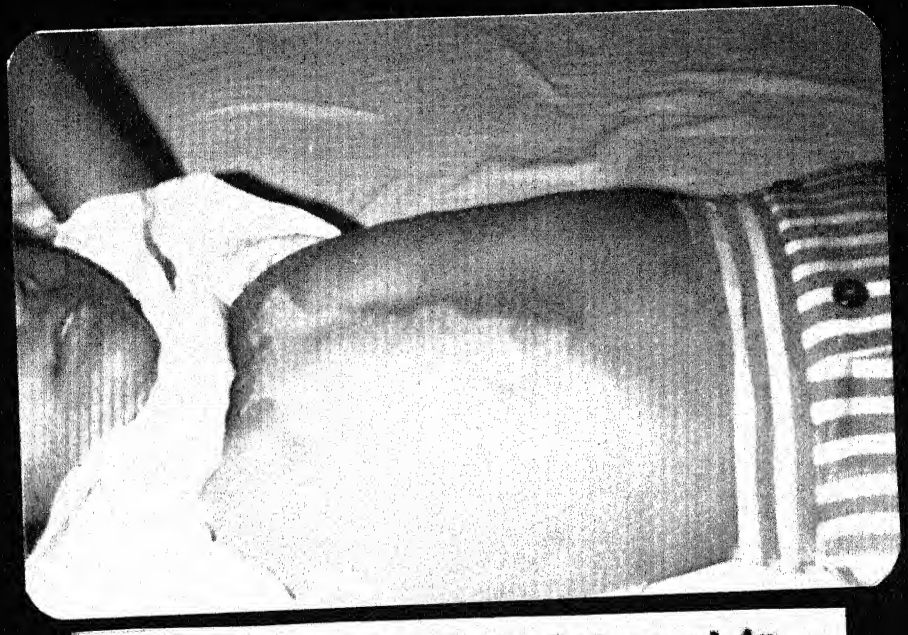


Photograph-9: Showing healed burn wound on 10th day of membrane application in the patient as shown in photograph-8

Photograph-10: Showing healed burn wound on 10th day of membrane applicati on in the patient as shown in photograph-8.

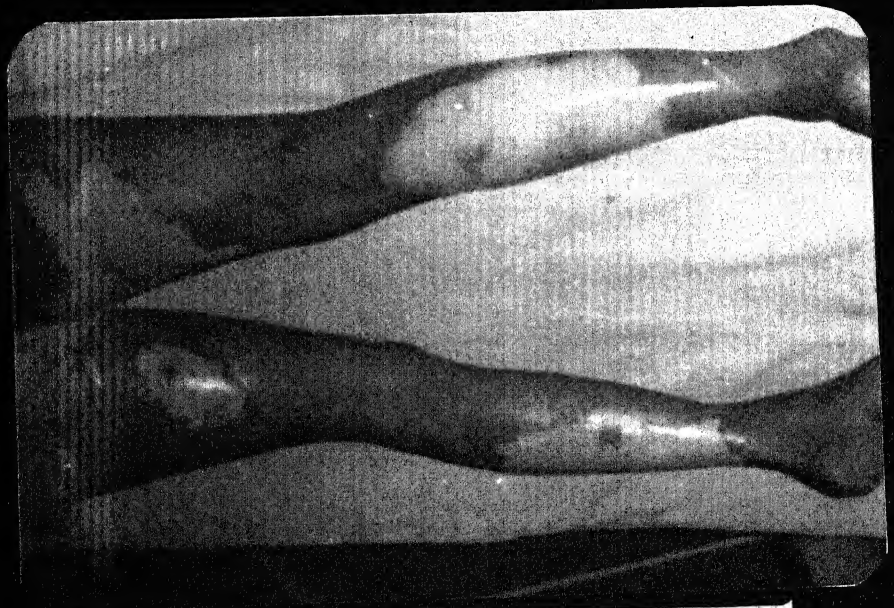
Photograph-11: Showing burn wounds immediately after application of full thickness membrane.

Photograph-12: Shows drying up of membrane (photograph taken after 36 hours of membrane application).



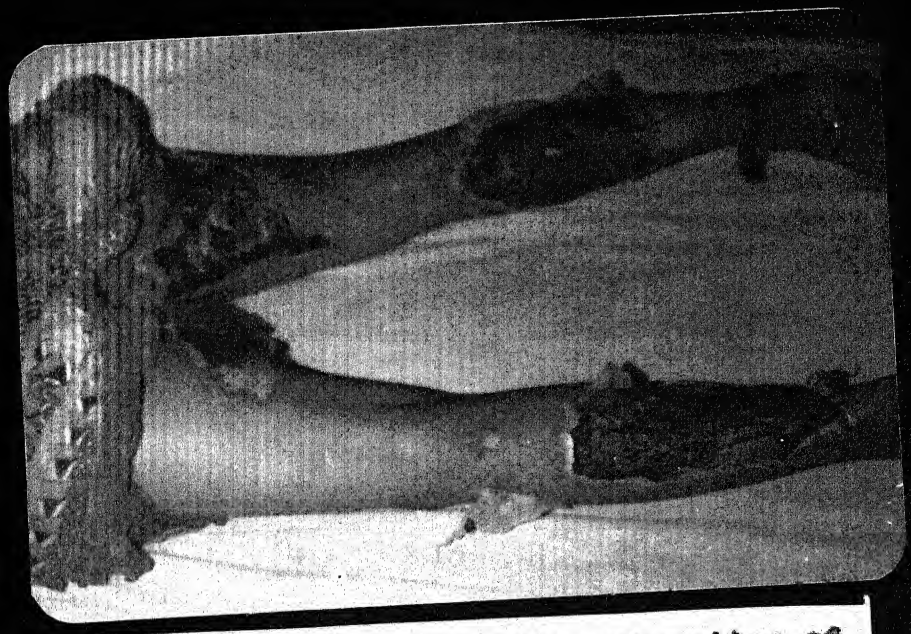
Photograph-13: Shows healed wound in the same patie-nt as in photograph-11 (photograph taken on 12th day).

Photograph-14: Shows healed wound in the same patient as in photograph -11 (photograph taken after 1 month).

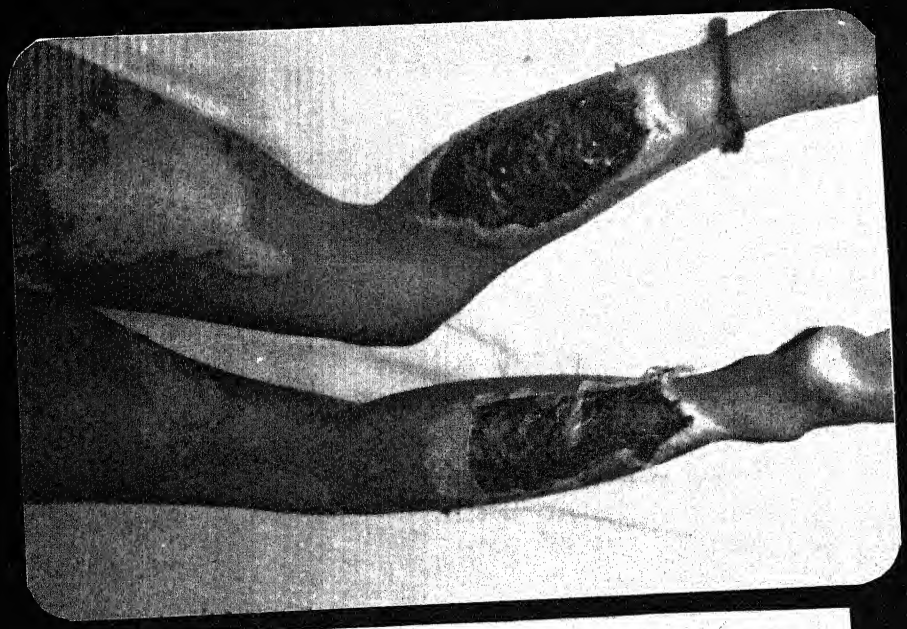


Photograph-15: Showing burn wounds immediately after amniotic membrane application.

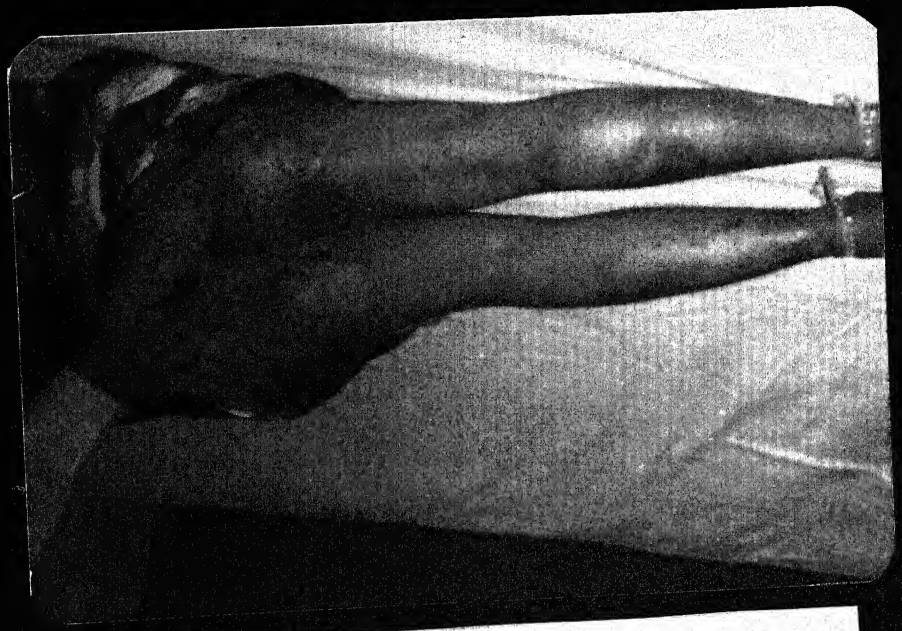
Photograph-16: Showing dried membrane on the same patient as in photograph -15. Margins of membrane shows curling up of the membrane as it is drying (photograph taken after 48 hours).



Photograph-17: Shows the seperation of membrane from the margin of the wounds (photograph taken on 11th day).



Photograph-18: Shows complete separation of membrane from the wound over thigh. Membrane applied over leg wounds in process of separation. (photograph taken on 15th day).



Photograph-19: showing healed wounds with pigmentations in same patient as in photograph-15 (photograph taken on 18th day).

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DISCUSSION

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DISCUSSION

Since the introduction of the "Biological Dressings" by Brown (1953) in the treatment of burn wounds, a number of investigators (Song 1966 , Shuck 1969, Rappaport 1970) have emphasized the effectiveness of homografts and xenografts in controlling infection and minimizing the loss of protein and fluids from the burnt surface. Silverstein (1971) and his colleages have reported xenografts to be inferior to allografts in decreasing bacterial count. They have related this failure to poorer adherence to the wound with xenografts. Rappaport and his co-workers(1970) have reported that xenografts left in place for more than 24 hours will not control the growth of bacteria. Collagen sheets are expensive and not available at every centre. A number of investigators have demonstrated the clinical feasibility of treating burn wounds with foetal membranes. Foetal membranes are easily available and are of no cost to the patient. They adhere well and obtain a biologically closed wound. Pigeon(1960) have stated that since the amniotic membrane is formed from the ectoderm of the foetus, it is like an extension of the skin of the body.

The present work is the study of the effectiveness of amnion and full thickness foetal membrane(amnion and chorion). Their results as regard the relief of pain, control of oozing and infection and rate of healing are also compared. This study was done on the patients of burns involving less than 50% of body surface area, without considering their age, sex , occupation,socio-economic status, mode and cause of injury and contamnation of wound.

As regard the incidence there was not much difference in either sex. Out of 31 cases studied, male sufferers were 13 and female were 18. 30 cases were below 30 years of age. This signifies that incidence is much higher in younger age group. This may be possible that younger persons are more engaged in daily activity, therefore they are more prone to sustain burn injury. Thermal injury appeared to be the main cause of burn. 21 cases sustained burns while cooking food, 3 cases by lamp while studying in lantern light, and 5 cases had burns due to scalding.

Total 31 cases were studied. 18 cases were treated with amnion alone, 8 cases with full thicknes membrane, and in 5 cases both amnion and full thickness membrane were applied. Thus total 36 wounds were considered.

Dino (1966) has reported the testing of many agents to sterilize the membranes and found the Normal saline with 10 lac unit of crystalline penicillin and 1 gm of streptomycin sulphate to be the best. In the present study membranes were collected from labour room and obstetrical operation theatre, and were used either fresh or were preserved in normal saline treated with 10 lac units of crystalline penicillin and 1 gm of streptomycin sulphate, at 4° c as suggested by Dino. They were used at different intervals after procurement and no difference was found in either membranes regarding their effectiveness. They retained all their biologic properties as does a fresh membrane. This suggests that both the foetal membranes can be easily collected and stored for use without changing their biologic properties. Robsen et al(1973) suggested that any subsrance chosen to sterilize the membrane should not in itself be so chemically powerful as to change biologic effectiveness of the membrane.

The use of chorion or intact amnion and chorion was suggested for deep burns as (i) it eliminates the need to separate the membranes at the time of preparation (ii)thicker intact membrane appears not to dessicate on the wound as quickly as does the amnion alone, Idem(1973) reported that bacterial growth is decreased most effectively when the biologic membrane achieve an initial 'take' onto a granulating surface. The drawback with xenograft is related to its mobility and lack in this initial 'take up'.

Amnion, chorion and combined amniotic membrane have been used by various investigators as a substitute for skin in the past. Most investigators have had a preference for one or the other of the membranes. Jenner studied amnion and chorion side by side in the same wound and found no demonstrable difference the two. Similarly Dino(1965) experimented with various layers of foetal membranes and found the end results practically the same. In the present study 23 wounds were treated with amnion alone and 13 wounds with intact Amnion and Chorion, and the results were consistent with above studies.

It was remarkable to note that pain and discomfort disappeared immediately after application of membrane. Only one out of 23 amnion treated wounds and one out of 13 full thickness membrane treated wounds required analgesics and sedatives for relief of pain proving thereby that both the membranes are helpful in decreasing pain and discomfort of the patient which is the most common symptom in a burn patient. This relief in pain is probably due to coverage of exposed nerve endings which are irritated when left exposed. Dino(1965) stated that the disappearance of pain is due to the soothing effect of the soft mucoid surface of the membrane, protecting the nerve endings

from the irritant factors which may be the only surrounding air. He further commented that since the relief is immediate it is not a chemical process like local anaesthesia which takes some time to take effect. In other words, the process could be one of mechanical barrier as afforded by the epidermis.

No allergic reaction was noted in any case, proving thereby that foetal membranes do not cause any allergic reaction when used as dressings. This is in accordance with other reports published from time to time.

Another observation was drying up of covered areas within 24-48 hours, thereby stopping oozing. The membranes adhered well to the wounds and obtained a biologically closed wound. Adherence has been proposed to be the most important property of biological membranes. According to Dino(1965) cessation of oozing is probably not due to mechanical occlusive pressure, but it is an augmentation of the co-agulum of plasma on the raw surface thereby sealing the pores. The coagulating fibrin then invades the meshes of the membrane and prevents the passage of fluid through it, at the same time making it adhere to the raw surface. The technique of applying the membrane over normal skin beyond the borders of the burn seals the periphery of the raw area.

Out of 36 wounds considered, 6 amniotic membrane treated and one full thickness membrane treated wounds developed infection. Out of these 7 wounds, 1 wound developed localized infection which was treated by splitting the membrane at that site and systemic antibiotics. In remaining 6 wounds membranes were rejected due to generalized pus collection and in all membranes were reapplied. In 2 amniotic membrane treated wounds

membranes were again rejected, probably due to failure to control infection. Culture of these infected wounds showed that staphylococcus and pseudo monas were the main organism. This difference in infection rate in 2 types of membrane treated wound is not significant because it is quite possible that (i) these wounds were not thoroughly cleaned so as to destroy the pathogens already present over the wound (ii) sterility of the membranes is not guaranteed as no culture of membranes was done after their preservation.

In the remaining 29 wounds there was no infection. This suggests that both membranes help to obtain biologically closed wound and prevent the assess of bacteria from outside, thus preventing the infection. Several authors have suggested that foetal membranes have unique antibacterial action. Allantoin, a bactericidal product of purine metabolism, immunoglobulins, and lysozymes, a bacteriolytic protein are all present in amniotic membranes and have been proposed as antimicrobial factors (Rosen 1973). Morris et al (1966) credited observed decrease in bacterial count to intimate biological closure of the open wounds by the membranes. Dino (1965) explained the absence of infection at the grafted sites as a contribution of several factors (i) the cleaning of the burn areas pregrafting must have killed or removed whatever bacteria may be there(ii) the antibiotic preservative may have killed the bacteria (iii) the sealing effect of the dried adherent membrane may have prevented the proliferation of surviving aerobic pathogens by shutting off the atmospheric oxygen (iv) the dried membrane becomes a mechanical barrier preventing the assess of bacteria in the environment into the raw burnt surface.

21 amniotic membrane treated wounds ~~within~~ healed within 25 days(3 wounds healed in 6-10 days, 10 wounds in 11-15 days, 4 wounds in 16-20 days and 3 wounds in 21-25 days). Similarly 12 full thickness membrane treated wounds healed within 25 days (7 wounds in 6-10 days, 1 wound in 11-15 days, 2 wounds in 16-20 days and 2 wounds in 21-25 days. One amniotic membrane treated wound healed in 26-30 days and one amniotic and one full thickness membrane treated wounds healed in 36-40 days. These latter 3 wounds were among those which developed infection, which could have delayed the healing process. These results show that both the membranes are equally good in promoting healing process. Early healing with membranes may be explained as a contribution of several factors (i) by covering the wounds, conversion of superficial burns to deep burns is prevented (ii) normal dermal cells which are left over the wound after injury, are prevented to destroy by covering them with membranes (iii) absence of infection is also an important factor in early and better healing . Dino (1965) observed that the crust formed under the membrane remained dry and free from infection untill their peeling off from 9th to 20th days. They became corrugated, hard and tough thus affording a good protective covering for the underlying delicate healing skin.

The healed skin treated by two membranes showed no differences. 29 healed wounds were pink,smooth and had flat margins.Four healed wounds had pink and raised surface with flat margins and two wounds had red raised surface with flat margins.Both latter wounds developed Keloid. Two cases developed contracture both involving neck area and the cause of contracture was lack of patient's co-operation.

Hansen (1950) in his study noted that enclosing a wound in plaster of paris leads to thick and raised granulation

tissue over skin margin, but with amnion grafting, granulation tissue never raises above the skin margin. Pigeon (1960) reported that (i) the normal discolouration in most cases of primary healing of burns was absent when wounds were examined after several weeks in amniotic membrane treated cases (ii) immediate protection of injured cells of dermis prevents the destruction of underlying cells, which if occur would be replace by fibrotic tissue leading to scar formation, Chao et al (1940) and Troensagaard- Hansen (1960) also have noted that amniotic membrane seemed to possess some specific healing power. They have reported a stimulation of both fibrous tissue growth and more rapid epithelial repair.

Thus it can be concluded that both foetal membranes fulfilled all the functions of an ideal biological dressings. In terms of their large size and easy availability without cost to the patient, they are actually superior to the homograft and heterograft skin. They minimized protein and fluid losses and resulted in marked relief of pain and discomfort. They appeared to increase the rapidity of epithelization. The nontoxic and non antigenic nature of the membranes as well as their adherent qualities, make it an excellent biological covering for the burn surface.

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CONCLUSION

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CONCLUSION

The effect of amniotic membrane and full thickness membrane (amnion and chorion) were studied and compared in 31 cases of burns, involving less than 50% of body surface area and following conclusions were drawn :

1. Females are 1½ times more sufferer than males for they are exposed to danger due to house work.
2. The incidence of burn is much higher in younger age group i.e. below 30 years of age.
3. Most of the burns are thermal in nature.
4. Both the membranes provide good coverage to raw area.
5. Amnion and full thickness membranes are easily collected and preserved and they can be used safely several days after preservation without changing their biological nature.
6. Both the membranes convert an open wound into biologically closed wound thus preventing protein and fluid losses from the raw surface, at the same time they prevent infection from outside.
7. They help to prevent conversion of superficial burns to deep burns thus promoting healing.
8. The discomfort and sufferings of the patients is immediately removed after membrane application which is the only distressing sympton on admission.
9. The quality of healed wounds is equally good in either membrane application. Healed wounds are pink, smooth with flat margins.

On comparing the two membranes following conclusions were drawn :

1. Full thickness membrane takes longer time to become dry in comparision to when amniotic membrane alone is applied.
2. Full thickness membrane is easy to prepare as it avoids need to separate amnion from chorion.
3. Amniotic membrane alone is superior to full thickness membrane as (i) it is fairly strong and stretchable and can cover a wider area (ii) it is not contaminated with maternal blood, therefore it can easily be cleaned.
4. Both the membranes are equally effective in alleying pain and discomfort, stopping oozing from raw surface, preventing assess of micro organism from outside into the raw surface, and promoting healing.

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